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HARVARD SCHOOL
OF
PUBLIC HEALTH

*Announcement of Courses
and General Information*



1973-74

677 Huntington Avenue, Boston, Massachusetts 02115

PUBLISHED BY THE UNIVERSITY



Graduate students from many parts of the world come to study in Harvard's School of Public Health. Physicians, engineers, physical scientists, social scientists, and other health specialists prepare here for careers of leadership in teaching, research and the administration of health services, both nationally and internationally.

The Harvard School of Public Health operates as an autonomous unit of Harvard University in close association with the Faculties of Arts and Sciences, Divinity, Government, Business Administration, Education, Law, Medicine and Dental Medicine.

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SEBASTIAN S. KRESGE EDUCATIONAL FACILITIES BUILDING
677 Huntington Avenue, Boston

ONE

INTRODUCTORY INFORMATION

ACADEMIC CALENDAR-1973-1974

- *SEPTEMBER 10 MONDAY, 10 A.M.** Opening orientation session and preliminary registration for new International Students
- *SEPTEMBER 12 WEDNESDAY, 2 P.M.** Opening orientation session and preliminary registration for new U.S. Students

The period between the opening sessions and September 19 will be devoted to orientation lectures, individual conferences with faculty members, and selection of courses of study.

- *SEPTEMBER 17, MONDAY, 10 A.M.** Opening session and registration for students enrolled in 1972-73.

FALL TERM, SEPTEMBER 19, 1973 THROUGH JANUARY 26, 1974

- SEPTEMBER 19, WEDNESDAY** First Period Courses begin
- OCTOBER 8, MONDAY** Columbus Day: a holiday
- OCTOBER 22, MONDAY** Veterans' Day: a holiday
- NOVEMBER 17, SATURDAY** First Period Courses end
- NOVEMBER 19, MONDAY** Second Period Courses begin
- NOVEMBER 22 and 23, THURSDAY and FRIDAY** Thanksgiving Recess

Recess from Thursday, December 23, 1973 through Sunday, January 6, 1974

- JANUARY 9, WEDNESDAY** Spring Term Orientation Day
- JANUARY 26, SATURDAY** Second Period Courses end
- JANUARY 28, MONDAY through FEBRUARY 2, SATURDAY** Directed reading period, supervised special studies or field observations

* All students are required to attend the opening session and to be present for the registration period.

SPRING TERM, FEBRUARY 4, 1974 THROUGH JUNE 13, 1974

FEBRUARY 4, MONDAY	Third Period Courses begin
FEBRUARY 18, MONDAY	Washington's Birthday: a holiday
MARCH 30, SATURDAY	Third Period ends

Recess from Sunday, March 31, 1974 through Sunday, April 7, 1974

APRIL 8, MONDAY	Fourth Period Courses begin
MAY 27, MONDAY	Memorial Day: a holiday
JUNE 1, SATURDAY	Fourth Period ends
JUNE 3, MONDAY through JUNE 12, WEDNESDAY	Post-class Period
JUNE 13, THURSDAY	Commencement

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SCHOOL OF PUBLIC HEALTH

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The School and Its Facilities

The Harvard School of Public Health is primarily devoted to graduate education in public health and its aim is to provide opportunities for those who seek careers in one or more of the principal areas of public health activities—teaching, research, and the administration of health services, both nationally and internationally.

Public health evolved from the early combination of medical science and engineering for the control of environmental hazards. It has grown to embrace various facets of the biological, physical and social sciences as community aspects of health problems have become more complex and demanding. Public health now depends upon the skills and knowledge of members of several professions. The role of a graduate school of public health today is to prepare those who will be concerned with health problems which exceed the scope of any single discipline, and which can be solved best through the skillful cooperation of specialists from the fields of medicine, engineering, management, and others.

HISTORY OF THE SCHOOL

Activity in professional education in the field of public health had been steadily increasing in Harvard University for more than two decades before the actual founding of the School in 1922. Its gradual development was characterized by certain important steps, the first of which was the establishment, in 1909, of the Department of Preventive Medicine and Hygiene in the Medical School—the first such department in the United States. The degree of Doctor of Public Health was first conferred in 1911. In this same year a Department of Sanitary Engineering was inaugurated in the Graduate School of Engineering. In 1913, the Department of Tropical Medicine and, in 1918, the Division of Industrial Hygiene, with clinical and laboratory facilities, were organized in the Harvard Medical School.

In 1913, the Harvard-Massachusetts Institute of Technology School

for Health Officers was formed under the joint management of Harvard University and the Massachusetts Institute of Technology. This School operated until the fall of 1922, when it was superseded by the Harvard School of Public Health, made possible by an endowment for this purpose from The Rockefeller Foundation.

When the School first opened, several departments of the new School operated as joint departments with the Medical School, with shared facilities, faculty and budgets. In 1946, the School was separated administratively and financially from the Medical School and became an autonomous unit of Harvard University. It continues to cooperate with the Medical School in teaching and research, and has also developed close association with other schools of the University, particularly the Graduate Schools of Arts and Sciences, Government and Business Administration.

OBJECTIVES OF THE SCHOOL

The objectives of the School of Public Health are the advancement of knowledge and graduate education in the relevant disciplines and problem areas of public health.

In its efforts to advance knowledge, the School is concerned with health problems of major importance to society, not only in the highly urbanized and technologically advanced regions, but also in the predominantly rural or economically disadvantaged areas of the world.

The educational program of the School offers advanced instruction in the community-oriented health sciences and in the techniques of administration for highly qualified men and women who have potential for imaginative leadership.

In its involvement in the contemporary health problems of society, the School collaborates with community leaders in seeking ways in which knowledge can be effectively used for the advancement of human health.

The School has the dual role of (1) a professional school that provides basic comprehensive knowledge in relevant health sciences and (2) a graduate school that provides advanced instruction and op-

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opportunities for study in depth for those students who seek to become specialists in one of the public health disciplines. To fulfill these roles, two different degree programs are offered. One leads to the professional degrees of Master and Doctor of Public Health. The other program leads to the degrees of Master and Doctor of Science in a public health discipline, and provides the opportunity to concentrate intensively in an area of special interest.

LOCATION AND BUILDINGS

The main buildings of the School of Public Health are the Health Sciences Laboratories at 665 Huntington Avenue, and the Sebastian S. Kresge Educational Facilities Building, 677 Huntington Avenue, Boston. These buildings are near the Harvard Medical and Dental Schools, the Countway Library of Medicine, the Children's Hospital Medical Center, and the Peter Bent Brigham Hospital, and other hospitals.

HEALTH SCIENCES COMPUTING FACILITY

Computing and data processing services are available to students through the Health Sciences Computing Facility, which is operated by the School of Public Health. A staff of systems analysts and computer programmers assists researchers and students from all the Harvard Medical Area institutions in using the computer as a tool for analyzing data, for doing extensive numerical calculations and for acquiring, maintaining, and processing large data bases.

HSCF is equipped with unit record machines, including a counting card sorter and a variety of card punching machines. Remote batch processing computing is accomplished by a high-speed telephone link to the IBM 370/165 computer at the Massachusetts Institute of Technology. Interactive computing (time sharing) capability is provided by low-speed terminals which are connected to several large computers in the New England area, notably the Honeywell 635 at Dartmouth College. Many projects use the optical scanning machine at HSCF to convert data into machine-readable form.

HSCF staff members give a short course in computing (Biostatistics 213e) at the end of each Term. There are also special tutorials for interested students who have had prior computing experience. The Director of the HSCF is Mr. Raymond Neff.

LIBRARIES

The library needs of the School of Public Health are served principally by the Francis A. Countway Library of Medicine, located at 10 Shattuck Street. The Countway Library combines the resources and services of the Harvard Medical Library and the Boston Medical Library. Among libraries serving medical and health-related schools, it is the largest in the country with recorded holdings of more than 435,000 volumes and 5,300 periodicals. The Countway Library also has extensive collections of historical materials, dating from the 15th Century. Its History of Medicine Department provides modern facilities for the use of these books and other rarities.

All members of the University may borrow from the College Library at Cambridge. Messenger service is provided daily between the College Library, various other Harvard University Libraries, and the Countway Library. The Boston Public Library, the libraries of the Massachusetts Institute of Technology, and libraries of the Boston area add to the total book and periodical resources available to students.

OTHER RESOURCES

Students at the School may enroll in courses in other Schools of Harvard University, such as in the social sciences, public administration, economics, statistics and medical sciences. Certain graduate courses at the Massachusetts Institute of Technology are also open to students of this School.

The School maintains a close association with a wide variety of health, medical care, and welfare organizations in Massachusetts and elsewhere. The facilities of hospitals and institutions adjacent to the School are available to qualified students. Other medical facili-

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ties, hospitals, health departments, private health and welfare agencies, and community planning groups provide opportunities for observation and special studies, and members of their staffs are available to assist in the School's educational program. At the local level, administrative methods may be studied in some of these agencies in the Greater Boston Area.

The State Laboratory Institute of the Massachusetts Department of Public Health performs a wide variety of bacteriological, immunological and chemical procedures, and is engaged in several research programs. The Laboratory provides excellent opportunities for qualified students who wish to obtain intensive experience in many types of laboratory methods that are pertinent to public health.

TWO

ADMISSION AND DEGREES

Application for Admission

Applicants must submit the following for consideration by the Committee on Admissions and Degrees: (1) completed application form; (2) transcripts of academic record at college, graduate school and/or professional school; (3) names of at least three people, well acquainted with the applicant's previous work, from whom the School may request letters of reference.

An application fee of \$15, which is not refundable, is required for each formal application. A check drawn on a bank in the United States, a postal money order, or an international money order, payable to the Harvard School of Public Health, must accompany the application.

Applicants from countries in which the language of instruction is not English must satisfy the Committee as to their ability to speak, read, write and understand the English language competently. The applicant ought to have sufficient knowledge of English to enable him to understand lectures in English, to participate in seminar discussions and to write examinations. In the absence of sufficient evidence from the sponsoring agency and other sources, the School may request that the applicant take and pass satisfactorily the Test of English as a Foreign Language, Box 899, Princeton, New Jersey, 08540, U.S.A. If, upon arrival at the School, a student's command of English is not found to be adequate, he may be required to take further instruction in English.

In addition to fulfilling the specific requirements for admission to a degree program, applicants must satisfy the Committee as to their ability to undertake advanced study at a graduate level. The final decision as to the admissibility of an applicant rests with the Committee on Admissions and Degrees.

The School is unable to accept all who are eligible for admission. Therefore, persons who wish to be considered for admission are urged to submit their applications by February 1st prior to the academic year in which they wish to enroll. However, applications

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which are completed by *March 1st*, will be considered, subject to availability of space. Applications for admission to Spring Term should be submitted by *November 1st*.

Admission of a candidate for one academic year does not automatically admit him in a subsequent year; re-application is considered on the same basis as a new application.

All inquiries and communications regarding admission should be addressed to the Director of Admissions, Harvard School of Public Health, 677 Huntington Avenue, Boston, Massachusetts 02115.

Living Expenses

Living costs in the Boston area are higher than in most areas from which students come. Therefore, the school has adopted the policy stated below in regard to applicants for admission from outside the United States.

An applicant whose financial support is not guaranteed by an official U. S. agency or foundation must submit evidence satisfactory to the School that he will have sufficient funds available in U. S. currency to enable him to pay his expenses during the academic year. The minimum amount needed by a single person, in addition to travel, is \$6,350, to cover cost of tuition (\$3,200) and living expenses of at least \$350 a month for approximately nine months. If an applicant plans to bring his family, he must have at least \$1,800 more for his wife and \$900 for each dependent child, in addition to travel expense. Certification of adequate financial resources must be received by the School before the immigration form needed to obtain a visa to enter the U.S. can be issued to the student.

Courses of Study and Degrees

MASTER OF PUBLIC HEALTH DEGREE

Programs leading to this degree provide a broad background in one of several combinations of the disciplines basic to public health, and are designed primarily for students intending to enter the practice of public health.

Requirements for Admission

1. Applicants may be considered for admission as candidates for the Master of Public Health degree if they satisfy one of the following minimum requirements:

a) Graduation from an approved school with a doctoral degree in a field considered by the Faculty to provide a sufficient basis for a career in the practice of public health. At present, acceptable qualifications in this category include doctoral degrees in medicine, dentistry, veterinary medicine, administration, behavioral science, biology, economics, engineering, law or government.

b) Enrollment in a course of study leading to one of the above degrees when joint programs for the degree and the Master of Public Health have been specifically approved. At present, such joint programs have been approved only in connection with M.D. and D.M.D. programs.

c) In exceptional instances, the Committee on Admissions and Degrees may consider a period of public health experience, in conjunction with an appropriate bachelor's or master's degree with honor grades, as providing an acceptable basis for consideration for admission to a Master of Public Health program.

2. Persons with these qualifications must satisfy the Committee on Admissions and Degrees as to their scholastic ability to study at a graduate level.

Requirements for the Degree

1. One academic year must be spent in residence at the University.

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2. The student must complete successfully courses totalling a minimum of 40 credit units.

3. Each student's program must include courses that represent adequate coverage in the three areas described below. For a given student's program, no single course shall satisfy the requirement in more than one of the following areas:

- a) Fundamental knowledge and concepts about man, with particular attention to his interaction with the (1) physical, (2) biological and (3) social (including psychological) environment, and the effects of that interaction on his health. *Study programs will ordinarily include introductory courses in at least two of these three sub-areas.*
- b) Basic techniques of investigation, measurement and evaluation, with emphasis on their use in understanding health in human communities. *Study programs will ordinarily include the introductory courses in biostatistics and epidemiology.*
- c) Basic approaches to policy planning and program management and their application to the promotion of community health within the social, economic and political setting relevant to health services. *Study programs will ordinarily include one of the introductory courses in health services administration.*

The extent of coverage in the above three areas must meet the approval of the Master of Public Health Review Committee.

MASTER OF SCIENCE

**(With Designation of a Field of Concentration
or the Program in Health Policy and Management)**

This degree is granted on fulfillment of a program of advanced work in one of the disciplines of public health represented in the School. Generally speaking, programs are designed for students with interests in the scientific basis of public health and preventive medicine.

Requirements for Admission

Applicants may be considered for admission as candidates for the

Master of Science degree on the basis of a one-year or a two-year program if they meet the minimum requirements in one of the following categories:

One-year Program:

1. Graduates of approved schools of medicine, dentistry or veterinary medicine.
2. Holders of a doctoral or master's degree from an approved school in fields acceptable to the department of concentration.
3. Applicants in industrial hygiene, air pollution control, radiological health and public health engineering who meet certain requirements with respect to academic background and experience. Normally this includes receipt of a bachelor's degree with honor grades (including adequate undergraduate training in physics, biology, chemistry and mathematics) supplemented by at least two years of relevant professional experience in the chosen field of specialization.

Two-year Program:

Applicants with a bachelor's degree with a distinguished academic record in areas acceptable to the department of concentration. A year of appropriate graduate work in another approved institution may be accepted as the first year of this program.

The academic background of the individual applicant must be appropriate for a program of study offered by one or more departments of the School. Inquiries concerning these programs should be addressed to the intended department of concentration.

Persons with appropriate qualifications must satisfy the Committee on Admissions and Degrees and the department within which they choose to specialize as to their potentiality for successful study at a graduate level within the School.

Requirements for the Degree

1. The student must spend a minimum of one year in residence at the University and must complete successfully a program of at

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least 40 credit units. Candidates in the two-year program must obtain at least 80 credit units.

2. All candidates for the degree are required to take Biostatistics 101a,b and Epidemiology 201a, unless they can demonstrate equivalent preparation. Candidates who do not have a background in medicine or biology are advised to take Physiology 203a,b, or a course in general biology elsewhere. For candidates enrolled in the Program in Health Policy and Management, the preceding requirements are met in the following prescribed first-year courses: Interdepartmental 213a,b,c,d; 214a,b,c,d; 215a,b,c,d; 216a,b,c,d. The remainder of the program is devoted to courses which may be prescribed by the department of concentration and to elective courses in the primary and related fields of interest. These courses are described on pages 73-145. Courses offered by other Faculties of the University are also available.

MASTER OF INDUSTRIAL HEALTH

A program of courses leading to a Master of Industrial Health degree is designed to meet the needs for postgraduate training in the public health disciplines which are relevant to the development of preventive medical programs in industry. This degree program is usually taken as part of a two-year approved residency in occupational medicine.

Requirements for Admission

Candidates must be graduates of an approved school of medicine and must also satisfy the Committee on Admissions and Degrees as to their scholastic ability to study at a graduate level. Students from the United States must have completed an internship or residency of at least twelve months in a hospital approved by the American Medical Association.

Requirements for the Degree

1. One academic year must be spent in residence at the University.
2. The student must complete successfully the required and elec-

tive courses to a minimum total of 40 credit units. All candidates for the degree are expected to take the following courses unless they can demonstrate equivalent preparation:

<i>Course</i>	<i>Credit units</i>
Principles of Biostatistics (Biostatistics 101a,b)	3.5
Principles of Epidemiology (Epidemiology 201a)	2.5
Principles of Environmental Health (Environmental Health Interdepartmental 201a,201b)	4
Radiation Protection (Environmental Health Sciences 271a,b)	5
Basic Problems in Occupational Health and Industrial Environments (Environmental Health Sciences 251c,d)	5
Total	<hr/> 20

In addition, the student may select courses from the curriculum approved for residencies in Occupational or Aviation Medicine.

DOCTOR OF PUBLIC HEALTH

For the degree of Doctor of Public Health the student must complete an approved program of independent and original investigation in a special field and must present the results of this research in an acceptable thesis.

Requirements for Admission

1. An applicant for admission to candidacy for this degree must be either (a) a graduate of an approved school of medicine, dental medicine or veterinary medicine, or (b) the holder of another doctoral degree in one of the basic sciences related to public health.
2. The applicant must hold the degree of Master of Public Health or its equivalent from an approved institution and must have demonstrated potential ability to undertake original investigation in a special field.
3. Admission to doctoral candidacy is considered provisional until the candidate has passed the oral qualifying examination.

DOCTOR OF SCIENCE

(With Designation of a Field of Concentration)

This degree is granted on successful completion of a program of independent and original research in one of the basic disciplines of public health, and the presentation of this research in an acceptable thesis.

Requirements for Admission

Candidates for the degree of Doctor of Science must hold the degree of Master of Science or its equivalent and must indicate ability to undertake original investigation in a special field.

Admission to doctoral candidacy is considered provisional until the candidate has passed the oral qualifying examination.

REQUIREMENTS FOR DOCTORAL DEGREES

Residence

The student is required to complete a minimum of one academic year in residence. However, the required work and preparation of an acceptable thesis normally require at least two full years and frequently longer.

"Residence" requirements are fulfilled by payment of tuition and pursuit of an approved program. The first year is almost invariably in actual physical residence at the School. Subsequently, the thesis work may be continued at the School, or, in special circumstances, may be done *in absentia*. For thesis work done *in absentia*, the Adviser and the appointed evaluators must meet with the candidate to appraise the thesis plan. Agreement must be reached and the Committee on Admissions and Degrees must be advised in writing prior to the departure of the student as to:

- (a) The acceptability and feasibility of the proposed thesis plan
- (b) The timing and scope of periodic written reports which will be required of the student
- (c) Arrangements which have been or can be made for direct field supervision of the student

- (d) The minimum period of time the student will spend at the School prior to submitting his thesis for appraisal by the Readers; a minimum of four months is recommended.

Doctoral Program Adviser

After the student enrolls in the School as a provisional doctoral candidate, a Doctoral Program Adviser is appointed by the Department of concentration. This Adviser keeps the student informed of all procedures and requirements for the degree, advises him about proper courses to be taken; decides, together with the Department, when the student is prepared to take the qualifying examination, and supervises the thesis work.

Qualifying Examination

The qualifying examination for admission to full doctoral candidacy consists of Part A and Part B.

Part A is administered by the Department of concentration, and consists of a thorough examination in the field of concentration and closely related areas. As many of the Departmental Faculty as possible should be involved in this examination. The examination may be written, oral, or both — at the discretion of the Department. On satisfactory completion of this part of the examination, the candidate is eligible to take Part B.

Management of Part B is the responsibility of the Committee on Admissions and Degrees and the Registrar. It is an oral examination in the field of concentration and at least two other relevant fields. In the field of concentration the examination focuses on the candidate's imaginative use of principles and ability to apply his knowledge, rather than his basic background of knowledge which has already been tested in Part A. The other fields of examination need not necessarily be related to the student's thesis topic; they are selected by the Department of concentration with approval of the Committee.

Both parts of the qualifying examination should normally be completed within one year of registration as a provisional doctoral candidate. Part A is scheduled by the Department and Part B by

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the Committee on Admissions and Degrees and the Registrar. Part B of the examination is open to all Faculty members; however, decision as to the outcome of the examination rests solely with the appointed examiners. The decision may be (a) pass, (b) general failure—requiring complete re-examination, or (c) specific failure—requiring re-examination only in the specified subject. Permission for re-examination rests with the Committee on Admissions and Degrees, on the recommendation of the examiners.

Evaluation of Candidate's Progress

After the candidate has passed the qualifying examination, two Faculty members are appointed to aid the Adviser in the periodic evaluation of the student's progress.

Form of Thesis

The thesis should consist of one or more manuscripts suitable for publication in a scientific medium appropriate to the candidate's field. If the work is published prior to submission of the thesis, copies of the publication may be submitted in lieu of manuscript. If not included in these documents, there should be added an introduction describing the historical setting and objectives of the work and a concise discussion that would provide an overall evaluation of its significance. Technical appendices should be added where necessary to demonstrate the full development of the thesis material.

Papers published under joint authorship are acceptable provided that the candidate has contributed a major part to the investigations. He is expected to be senior author on at least one of the papers. In the case of manuscripts published under joint authorship, the co-authors or the Adviser may be consulted by the Readers or the Committee on Admissions and Degrees to clarify the nature and extent of the candidate's contribution.

In addition to evaluating the quality and significance of the work, those responsible for accepting the thesis (the Department and the Readers) may determine whether the format is suitable for publication in a scientific medium appropriate to the candidate's field.

Evaluation of Thesis

The thesis must first be accepted by the Department of concentration. When it is, three unbound copies should be deposited in the Registrar's Office. On request of the Department, the Committee on Admissions and Degrees will appoint three or more Readers. When the Readers have individually evaluated the thesis, they will meet, together with one or more members of the Committee, and make a joint recommendation regarding acceptance of the thesis. If the thesis is accepted, the Committee on Admissions and Degrees may then recommend the candidate to the Faculty for the degree. The degree is voted by the Faculty at its special meetings in October, February or June.

The Readers, as individuals or at their meeting, may call on the student for clarification, augmentation or defense of material presented in the thesis.

The unbound copies of the thesis must be in the Registrar's Office before *January first*, for degrees to be awarded at mid-year, and *before April fifteenth* for degrees to be awarded in June. In order to meet these deadlines, the candidate should submit the completed thesis to his Department at least two weeks in advance of these dates.

An acceptable thesis must be submitted within 5 years of the date of registration as a provisional doctoral candidate.

Final Seminar

There is no formal public thesis defense. However, after acceptance of the thesis by the Committee of Readers, the Department of concentration is responsible for the arrangement of a seminar at which the candidate will present and discuss his thesis work. These seminars are announced throughout the School, and are open to Faculty, research staff and students.

Credit Assignment

Credit units are assigned on the basis of the total amount of time required by a course, both in class and outside of class. Twenty credit units constitute a full program for one term.

Special Students

Subject to availability of space, the School may accept a few students, on a full-time or a part-time basis, who are not degree candidates, but who are interested in taking one or more courses in a special field. Procedures and requirements for the admission of such students are the same as for degree candidates. Special students who later wish to be admitted to degree candidacy will be considered on the same basis as other applicants for admission. Admission as a special student carries with it no commitment to accept the applicant as a degree candidate.

Degrees in Engineering

Graduates of engineering colleges or scientific schools of recognized standing who are interested in environmental engineering may be admitted to the Division of Engineering and Applied Physics of the Graduate School of Arts and Sciences as candidates for the degree of Master of Science or Doctor of Philosophy. They may elect appropriate courses in the School of Public Health as a part of the program for these degrees.

For further information write to the Committee on Admissions, Graduate School of Arts and Sciences, Holyoke Center, 75 Mt. Auburn Street, Cambridge, Massachusetts, 02138.

THREE

CENTERS

The Kresge Center for Environmental Health

James L. Whittenberger, S.B., M.D., A.M. (hon.), Director

Dade W. Moeller, S.B., S.M., Ph.D., A.M. (hon.), Associate Director

This Center includes the Departments of Physiology, Sanitary Engineering, and Environmental Health Sciences. The Center serves as a focus for environmental health activities within the School of Public Health. It also represents Harvard University in the New England Consortium on Environmental Protection and conducts environmental health teaching and research activities elsewhere in Harvard University and at the Massachusetts Institute of Technology. Such projects include undergraduate courses in environmental health to students in Harvard and Radcliffe Colleges, and joint courses and seminars with the Division of Engineering and Applied Physics, Faculty of Arts and Sciences.

Full-time Faculty within the Center includes physicians, engineers, physiologists, psychologists, mathematicians, toxicologists, chemists, physicists, meteorologists and other professionals. This diversity enables the staff to deal effectively with environmental problems which require a multidisciplinary approach.

Specific subject categories in which the Center conducts research and training include:

1. Air Pollution Effects and Control
2. Environmental Physiology
3. Environmental Toxicology
4. Human Factors — Accident Prevention
5. Industrial Hygiene
6. Occupational Medicine
7. Radiological Health
8. Respiratory Physiology
9. Sanitary Engineering

Degree programs available within the above areas include the

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Master of Science, Master of Industrial Health, Doctor of Science and Doctor of Public Health. Formal requirements for each of these degrees are outlined in other sections of the catalogue. Students interested in any of the above areas ordinarily enroll in the School of Public Health. Students whose primary interest is in problems of water quality and water resources generally enroll in the Division of Engineering and Applied Physics of the Graduate School of Arts and Sciences.

Applicants desiring further details on any of these programs are encouraged to write to the Director of Admissions, the Head of the appropriate Department, or to the Director of the Kresge Center.

Center for the Prevention of Infectious Diseases

Thomas H. Weller, A.B., S.M., M.D., LL.D., Director

Roger Loyd Nichols, A.B., M.D., A.M. (hon.) Associate Director

The Center for the Prevention of Infectious Diseases is comprised of the Departments of Microbiology and of Tropical Public Health. Working in close collaboration, the staffs of the two Departments are concerned with the broad spectrum of agents, i.e., viral, rickettsial, bacterial, mycotic, protozoal, and helminthic entities, that parasitize man and with their relevant arthropod and molluscan vectors.

On a global basis the infectious diseases remain a primary cause of mortality. In the developed areas of the world, morbidity attributable to infectious diseases persists as a major impediment to the enjoyment of complete health. An increasing number of chronic degenerative diseases are recognized as stemming from the insults of prior infectious processes. In many societies, acceptance of the concept of population control awaits containment of undue mortality induced by the infectious diseases and the consequent assurance that children who are born will have a reasonable prospect of achieving maturity. Considerations such as the foregoing emphasize the continuing need for the public health expert to possess knowledge of the rapidly changing technology of the control of infectious diseases, as well as a basic knowledge concerning the attributes and epidemiologic characteristics of the responsible agents.

The Faculty of the Center for the Prevention of Infectious Diseases operates in close collaboration to discharge a common responsibility for multidisciplinary instruction in the various facets of diseases of infectious etiology. The formal course offerings of the two Departments are designed and scheduled to permit the acquisition of a broad basic knowledge of infectious diseases as well as an introduction to specialized subject areas. For advanced

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qualified students, concentration in specific areas with participation in collaborative or individual research is encouraged both at the pre-doctoral and the post-doctoral levels. The wide variety of current research projects in the Center permits acquisition of experience both at home and abroad, in the laboratory or in the field. Training grant funds are available for the support of qualified individuals specifically interested in public health bacteriology, rickettsiology, virology, mycology, parasitology, and tropical medicine.

Center for Population Studies

**Roger Revelle, A.B., Ph.D., S.D. (hon.), A.M. (hon.),
L.H.D., LL.D., Richard Saltonstall Professor of Popu-
lation Policy and Director of the Center**

**John C. Snyder, A.B., M.D., LL.D., Professor of Popu-
lation and Public Health and Medical Director of the
Center.**

**Elihu Bergman, A.B., A.M., Ph.D., Assistant Director and
Member of the Center.**

The Center for Population Studies was established in 1964 under the leadership of the School of Public Health, as a University-wide Center to join scholars and scientists in different fields in a common attack on human population problems. A Faculty Advisory Committee, representing all the Faculties of Harvard University, guides the operation and development of the Center. The Members and Research Associates of the Center are drawn from the Departments of Biology, Economics, Government, and Sociology; the Division of Engineering and Applied Physics; and the Schools of Public Health, Design, Education, Medicine, and Divinity. The Center maintains two offices, one in Boston in the School of Public Health, and one in Cambridge.

In the School of Public Health, the Department of Population Sciences welcomes qualified candidates for the various degrees offered by the School. Elsewhere in the University, courses and seminars open to all qualified students are given by Members of the Center in the Departments of Biology, Economics, Sociology, and General Education, in the Medical School, the Graduate School of Design, and the Divinity School.

The present research programs of the Center and the Department focus on several themes: laboratory and clinical research programs in human reproductive biology, aimed at developing new methods of human fertility control; economic, social, and environmental determinants and consequences of population change in the less developed countries, including public health aspects of fertility control and the

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balance between populations and their resources; problems of urbanization and internal migration in both developed and less developed countries; theories of population kinematics and dynamics and their implications for public policy; political and ethical aspects of population policy; historical population studies; population education; and adolescent growth and menarche.

Center for Community Health and Medical Care

Paul M. Densen, S.D., Director

The Center for Community Health and Medical Care was established under the joint auspices of the Faculties of Medicine and Public Health to serve as a focus for research and development in the organization, delivery, financing and evaluation of health care.

The interdisciplinary staff and faculty members of the Center are concerned with the design of experimental programs as well as the study of existing arrangements, mechanisms, institutions and related personnel involved in providing personal health services. Special emphasis is placed on evaluation and the refinement of evaluation methodology applicable to this field.

The Program of the Center includes:

1. Research in the organization and delivery of health services
2. Postdoctoral fellowship programs designed to prepare professionals with the capabilities to design, plan, manage and evaluate the instrumentalities and the systems for the delivery of health services

By its involvement of several Faculties of the University and by its programs for young physicians and other professionals, the Center provides a focus for the health activities of Harvard which are broadly directed toward the improvement of health services and medical care.

Center for the Evaluation of Clinical Procedures

Peter Braun, S.B., M.D., Planning Director

The Harvard School of Public Health has established a Center for the Evaluation of Clinical Procedures in response to the increasingly recognized need for better evaluation of diagnostic and therapeutic measures in current use or under development in medicine.

The Center will bring together professionals from various disciplines, including clinical medicine, statistics, law, ethics, epidemiology, and public policy, to cooperate in such activities as:

1. Survey and identification of clinical problems for current diagnostic or therapeutic modalities are of uncertain validity or merit
2. Investigation of the effectiveness of diagnostic and therapeutic procedures, including inquiry into the cost-benefit, public policy, ethical and legal aspects of procedures that are in use or proposed for adoption
3. Participation in the design and analysis of clinical trials, to be undertaken in teaching hospitals and elsewhere
4. Training clinical investigators, statisticians, and others in the principles of clinical research

FOUR

DEPARTMENTS AND CONTENT OF COURSES

Course Numbering

100–199	Undergraduate and Graduate Courses
200–299	Primarily Graduate Courses
300–399	Graduate Courses of Reading and Research

Interdepartmental Courses

Interdepartmental 201c. History and Philosophy of Public Health

Lectures. *One two-hour session each week, third period. Additional time and credit may be arranged.* Dr. MAYER and Dr. ROSENKRANTZ (Lecturer on the History of Science, Faculty of Arts and Sciences)

Credit 1 unit.

The course has two major purposes: to help the student of public health gain a picture of the development of his profession, and to use selected historical situations to illustrate how scientific knowledge has interacted in the past with political structure, economic status and cultural attitudes in the determination of the health goals of various societies and the execution of programs.

Interdepartmental 202. Introduction to Teaching of Community Medicine and Public Health

A self-paced, self-instructional course, supplemented by small-group discussion. May be taken any period. Dr. SEGALL and Mrs. VANDERSCHMIDT.

Credit 2 units.

This course is designed for students who are preparing for careers in the education of health professionals. A systematic approach to curriculum design is presented through a model program, which includes analysis of professional responsibilities, specification of educational objectives, evaluation of instructional processes, and outcomes and design of learning activities. Examples are drawn primarily from the fields of community medicine and public health.

Enrollment is subject to the approval of the Instructor.

Interdepartmental 203. Curriculum Design

A self-paced, self-instructional course, supplemented by small-group discussion. May be taken second, third or fourth period. Dr. SEGALL and Mrs. VANDERSCHMIDT.

Credit 2 units.

This course is recommended for students who currently hold faculty appointments in health professions schools, or who have reasonable assurance of such an appointment upon completion of training. Using the model for curriculum design developed in Interdepartmental 202, students plan a complete course in an area of individual selection.

Enrollment is subject to the approval of the Instructors.

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Interdepartmental Courses 204c,d. Seminars on Educational Policy

Seminars. *One two-hour session each week, third and fourth periods; time to be arranged.* Dr. SEGALL.

Credit 2 units. Additional credits can be arranged for those desiring extra instruction.

Seminars are offered on policy issues related to training programs in community medicine and public health for specific categories of health manpower, including physicians, dentists, and allied health professionals in the United States, and health professionals in developing countries. Through individual instruction and seminar discussions, students will assess the impact of professional expectations, social needs, and institutional constraints on the selection of educational goals.

Interdepartmental 208a,b. Human Rights in Health

Lectures. *One two-hour session each week, first and second periods.* Dr. CURRAN.

Credit 3 units.

This course entails a comprehensive examination of human rights as they bear upon health programs, nationally and internationally. Among topics considered from ethical, cultural, and legal viewpoints are: rights to medical care and a healthy environment; equality; rights of medical patients, women, children and experimental subjects; and problems of balancing personal rights and community protection.

Interdepartmental 209c,d. Health Services in the Developing Countries

Seminars. *One two-hour session each week, third and fourth periods.* Dr. MORROW, Dr. BERGGREN and Dr. LONG (Research Associate, Development Advisory Service).

Credit 2.5 units.

This problem-oriented course centers on the following issues: analysis of the special health problems facing developing countries and of the organizational alternatives for utilizing health resources; the nature, composition and training of the health team for use at the local and district levels; the relation of health to development and the position of health in national planning priorities. Students are responsible for presenting specific case studies concerning these issues.

Enrollment is subject to the approval of the Instructor.

Interdepartmental Course 210a,b. Economic Analysis for Public Health

Lectures and discussions. *Two one and one-half hour sessions each week, first and second periods.* Dr. BERRY and Dr. GAVAN.

Credit 4 units.

This course provides an introduction to the basic principles of economics and economic analysis particularly as they apply in the public health field. A systematic introduction to micro-economic theory includes the determinants of supply and demand, the theory of markets, and the concept of economic efficiency. In addition, attention is given to public expenditures and policy analysis.

Interdepartmental 212c. Biomedical Writing

Seminars. *One two-hour session each week, third period.* Dr. CHERNIN.

Credit 2 units.

Writing scientific papers is an integral part of the research process. This course is intended to develop practical skills and provide experience in planning and writing articles that meet the editorial demands of biomedical journals. The salient elements of a well prepared article—logical organization, good scientific prose, and understandable tables and figures—are emphasized by criticizing short papers written by the participants on biomedical subjects of their own choice.

Enrollment limited to ten students with advance approval of the Instructor.

Interdepartmental 213a,b,c,d. Human Biology and Medicine

Seminars and lectures. *Three one-hour sessions each week, first, second, third, and fourth periods. Laboratory and demonstrations to be arranged.* Dr. BRAIN, Dr. HIATT and Dr. DAVIDOFF (Assoc. Prof. of Medicine, Harvard Medical School).

Credit 10 units.

The first half of the course is an introduction to the major principles of human physiology and general pathology. Students examine basic physiological processes which characterize human cells, organs, organ system, and organisms as they respond to changing environments. Responses to injury as well as basic disease mechanisms are considered. Selected lectures, demonstrations, and physiological laboratory sessions emphasize major principles and examine some areas in depth.

During the second half of the course, students develop ability to analyze and utilize the elements of health care delivery systems through first-hand experience with health care skills and involvement with sick patients.

Enrollment is restricted to students in Program in Health Policy and Management.

Interdepartmental 214a,b,c,d. Quantitative Analysis of Health Problems

Seminars and lectures. *Three one-hour sessions each week, first, second, third and fourth periods. Additional computational sessions to be arranged.* Dr. JOEL COHEN and Dr. KLEINMAN.

Credit 10 units.

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The purpose of the course is to provide students with 1) motivation to analyze health problems quantitatively, 2) understanding of a broad range of quantitative techniques and ideas, 3) technical competence in a selected few techniques, 4) the critical capacity to evaluate realistically the power and limitations of quantitative analyses. Major topics include the theory of uncertainty and models of probabilistic systems, research design, data analysis, deterministic modelling, and optimization techniques.

Enrollment is restricted to students in Program in Health Policy and Management.

Interdepartmental 215a,b,c,d. Environmental Health Evaluation and Management

Seminars and lectures. *Three one-hour sessions each week, first, second, third and fourth periods. Additional laboratory and computational sessions to be arranged.* Dr. HARRINGTON and Dr. ———.

Credit 10 units.

This course introduces concepts and methods for evaluating and managing man's environment. Topics discussed include the development of natural resources, resulting environmental conditions and effects on human health. The course constitutes an introduction, on the one hand, to planning for environmental quality management and, on the other, to the use of epidemiologic and direct methods in assessing biological response to environmental insults.

Enrollment is restricted to students in Program in Health Policy and Management.

Interdepartmental 216a,b,c,d. Origins of Public Health Practice: Introduction to Welfare and Health Economics

Seminars and lectures. *Three one-hour sessions each week, first, second, third and fourth periods.* Dr. ROSENKRANTZ and Dr. MANNING (Assistant Professor of Public Policy, John F. Kennedy School of Government).

Credit 10 units.

This course examines the social context from which corporate responsibility for public health has emerged in Western nations, particularly in the United States. Specific problems in the development of public policy introduce historical methods in comparative studies, demography, epidemiology and bio-medical sciences. Included is a selective introduction to micro-economic principles and analysis. Examples relevant to health problems illustrate applications of economic analysis.

Enrollment is restricted to students in Program in Health Policy and Management.

Interdepartmental 300a,b,c,d. Teaching of Community Medicine and Public Health

Time and credit to be arranged. Dr. SEGALL.

Interested students may elect tutorial work in curriculum design, development of methods of instruction and evaluation, and other areas related to teaching community medicine and public health.

Department of Behavioral Sciences

ALEXANDER H. LEIGHTON, A.B., A.M., M.D., Professor of Social Psychiatry and
Head of the Department

Faculty: Professor Mertens; Associate Professors Beiser, Benfari, and
Murphy, J.

The Department of Behavioral Sciences has a primary concern with the relationship of social and cultural factors to mental health and mental illness. Allied to this is an interest in the way social, cultural, and psychological factors affect the development and effectiveness of planned changes, particularly those involving public health programs.

Students have the opportunity to study psychiatric epidemiology, cross-cultural psychiatry, the characteristics of community services, medical sociology, and the role of cultural factors in health and disease. Because of its crucial importance to all aspects of public health, special attention is given to studying factors which affect program acceptance — why people accept or reject certain public health programs. Throughout the curriculum considerable emphasis is given to research and research methodology.

The Department's teaching plan is therefore geared both to the student who has a social science background and wishes to know more about mental health and illness, and to the student who has a clinical orientation and wishes to know more about the social, cultural, and psychological influences which shape the human community. To supplement Departmental and School resources to achieve this end, the student may take additional courses in other parts of Harvard University such as the Department of Psychiatry and the Department of Social Relations.

The current research of the Department is focused on longitudinal community studies of mental health and mental illness, comparative psychiatric epidemiology, the effects of social and cultural change, the adjustment and adaptive processes of individuals and families after severe illness, the evaluation of psychiatric preventive measures, and the effects of intervention. In addition to being concerned with causal relationships and the building of significant theory, Departmental members give major weight to the development of methods, the revision of concepts, and the testing of reliability and validity of mental health survey techniques. Doctoral candidates and fellows have the opportunity of sharing in these studies as team members, and also of selecting a segment for independent investigation.

Behavioral Sciences 101b. Introduction to Behavioral Sciences

Lectures. *Two two-hour sessions each week, second period.* Dr. LEIGHTON and Staff of the Department.

Credit 2 units.

Not given in 1973-74.

Students are presented with working concepts from psychology, sociology, anthropology, and social psychiatry, which are useful in public health policy, planning, administration, and service delivery, and which bear upon the success or failure of public health programs.

Behavioral Sciences 202a. Advanced Topics in the Behavioral Sciences: Personality

Seminars. *One two-hour session each week, first period.* Dr. BEISER and Dr. BENFARI.

Credit 2 units.

Not given in 1973-74.

This seminar involves comparative analysis of selected theories and concepts of personality. The emphasis is on historical and current issues in the field of personality theory, and models of both normal and abnormal functioning are given attention. The aim of the course is to apply principles of personality to mental health research and public health programs. The course is especially appropriate for students planning a career in social psychiatry.

Enrollment is subject to the approval of the Instructor.

Behavioral Sciences 202b. Advanced Topics in the Behavioral Sciences: The Application of the Scientific Method to the Study of Behavior

Seminars. *One two-hour session each week, second period.* Dr. BENFARI.

Credit 2 units.

Not given in 1973-74.

This seminar covers various issues involved in the empirical study of behavior. Topics considered are: the nature of science, operationalism, models of causation, logical bases of inference, construct validity, clinical versus statistical prediction, and the difference between verification and discovery. The course is designed to prepare students for conducting research and utilizing research results in public health especially in the mental health field.

Enrollment is subject to the approval of the Instructor.

Behavioral Sciences 202c. Advanced Topics in the Behavioral Sciences: Social Processes

Seminars. *One two-hour session each week, third period.* Dr. MURPHY.

Credit 2 units.

Not given in 1973-74.

This seminar deals with various ways of conceptualizing and measuring social processes for relevance to public health with particular reference to

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mental health and mental illness. This includes studies of community integration, social class, and poverty. In addition, attention is given to the family, anomie, social networks, cultural values, and behavior settings. It is designed especially for students who plan to work in fields such as social psychiatry, medical anthropology, or medical sociology.

Enrollment is subject to the approval of the Instructor.

Behavioral Sciences 202d. Advanced Topics in the Behavioral Sciences: Field Surveys in Psychiatric Epidemiology

Seminars. *One two-hour session each week, fourth period.* Dr. LEIGHTON and Dr. BEISER.

Credit 2 units.

This course complements Behavioral Sciences 204c, and carries further the review of problems, concepts and methods in psychiatric epidemiology. Emphasis is given to the assessment of mental health in total populations, regardless of the utilization of treatment services and institutions. The course is primarily for students interested in social psychiatry.

Prerequisites: Behavioral Sciences 204c, or permission of the Instructor.

Behavioral Sciences 203a,b. Personality Assessment in Field Surveys

Seminars. *One two-hour session each week, first and second periods.* Dr. BEISER and Staff of the Department.

Credit 5 units.

Not given in 1973-74.

This course familiarizes the student with various data-gathering techniques such as clinical interviews, structured questionnaires, peer judgments and standardized observations used in studying mental health and illness in populations. One segment of the course deals with the conceptualization and measurement of positive adaptation; another deals with assessing mental health of children.

Enrollment is subject to the approval of the Instructor.

Behavioral Sciences 204c. Psychiatric Epidemiology: Problems, Concepts and Methods

Seminars. *One two-hour session each week, third period.* Dr. LEIGHTON and Staff of the Department.

Credit 2 units.

The aim of the course is to introduce students to the field of psychiatric epidemiology. Such major objectives as description, etiological investigation, and the applications of epidemiological methods to service needs are reviewed. Emphasis is on major psychoses such as schizophrenia and on the use of data obtained from psychiatric treatment services and institutions.

Prerequisites: Epidemiology 201a, Biostatistics 101a,b, or permission of the Instructor.

Behavioral Sciences 206b. Cross-Cultural Psychiatry

Lectures and Seminars. *One two-hour session each week, second period.* Dr. MURPHY.

Credit 2 units.

Not given in 1973-74.

Course topics include cultural relativity, cross-cultural epidemiology of psychiatric disorders, and the effects of rapid cultural change, poverty, and sociocultural disintegration. Indigenous practices for the treatment of the mentally ill in non-Western societies are discussed.

Enrollment is subject to the approval of the Instructor.

Behavioral Sciences 207c,d. Critical Issues in Community Psychiatry

Seminars. *One two-hour session and two hours of field work each week, third and fourth periods.* Dr. BEISER.

Credit 3 units.

Not given in 1973-74.

This series of sixteen seminars deals with the development of the community mental health movement in its relationship to psychiatry, public health, and social welfare. Preventive mental health programs are critically examined. Field work entails observing and reporting on local and state programs for the prevention of mental illness. Planning of research is encouraged.

Behavioral Sciences 208c,d. Urban Social Problems

Seminars and discussions. *One two-hour session each week, third and fourth periods.* Dr. BENFARI and Staff of the Department.

Credit 5 units.

Readings, cases, films, and discussions are employed to illustrate the functional complexity of current problems such as the urban process (historical and sociological overview), poverty in America and selected problems of education, employment, prejudice, discrimination, and polarization. The "c" period deals with the conceptualization of the problems; the "d" period focuses on specific problems, e.g., drugs and alcohol use.

Behavioral Sciences 210d. Inducing Social Change

Seminars. *One two-hour session each week, fourth period.* Dr. MERTENS and Staff of the Department.

Credit 2 units.

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This course is designed for various specialists in public health who are charged with responsibility for introducing changes in organizations and communities. The subject matter includes methods and theories of teaching, principles of individual and group psychotherapy, approaches to sensitivity training and group dynamics, and organizational theory. Techniques and procedures illustrating these theories are presented through readings, discussions, and case illustrations.

Behavioral Sciences 211d. Psychiatric Problems in Organizations and Industry

Lectures, readings, and case illustrations. *One two-hour session each week, fourth period.* Dr. MERTENS.

Credit 2 units.

The course is designed to provide basic information relevant to clinical and case management in industrial and other organizational settings. It analyzes research and clinical findings in such a way as to prepare students to handle not only individual maladaptation, but also disintegration at the organizational level. It presents successively etiology and symptomatology of individual and group dysfunction and is designed for students who already have a basic knowledge of psychopathology.

Enrollment is subject to the approval of the Instructor.

Behavioral Sciences 212c. Antisocial Behavior

Seminars. *One two-hour session each week, third period.* Dr. LEIGHTON and Dr. ROLDE (Instructor in Psychiatry, Harvard Medical School).

Credit 1 unit.

This seminar will deal with the nature and causes of behavior of juvenile delinquents, drug dependent persons (including alcoholism) and of persons with character disorders. Members of these groups are usually considered social deviants and their actions are strongly disapproved, frequently with little knowledge of the reasons why. Positive approaches to understanding and dealing with them will be emphasized, both in class discussions and in recommended readings.

Enrollment is subject to the approval of the Instructors.

Behavioral Sciences 300a,b,c,d,e. Tutorial Programs

Time and credit to be arranged. Staff of the Department.

Arrangements can be made for a reading course in selected topics or practical experience in research.

Behavioral Sciences 330e. Field Study

A limited number of openings exist for research experience in the Department's field stations. These opportunities vary in nature from time to

time according to the stages of various research projects. Individual arrangements can be made through the Head of the Department.

Behavioral Sciences 350. Research Training

Training in research is available to doctoral candidates through individual arrangements with the Staff of the Department.

Department of Biostatistics

JANE WORCESTER, A.B., DR. P.H., S.D. (hon.), Professor of Biostatistics *and* Acting Head of the Department

Faculty: Professors Feldman and Reed; Associate Professors Bishop, Drolette, Frazier and Miettinen; Assistant Professors Kleinman and Warram; Lecturer Jones.

The teaching aims of the Department may be divided very generally into three categories:

First, it is essential for workers in all branches of public health to be able to draw justified conclusions from numerical data and to base logical action on these conclusions. This applies to the administrator who must evaluate problems and the results of his activities, as well as to the epidemiologist and the research worker who must apply statistical techniques to their laboratory and field problems. The course, Biostatistics 101a,b. is therefore designed to give a minimum command of simple statistical methodology to all students.

Second, it is essential for field and laboratory researchers to be able to use statistical methods in planning and analyzing their experiments and problems. Elective courses are designed to provide an introduction to methodology in this area. These courses are adapted to the needs of students of this School, many of whom have broad backgrounds in biological sciences while few have extensive preparation in mathematics. A minimum of mathematical exposition is therefore included in courses intended for students in these categories. Instead the emphasis is on understanding the statistical procedures and the ability to carry out indicated analyses effectively.

Third, there is a smaller group of students particularly interested in pursuing further work along mathematical lines. Their requirements are fulfilled, on the one hand, by the provision of advanced and seminar courses in the Department; on the other, by the offerings of the Department of Statistics in the Graduate School of Arts and Sciences.

Training in the use of computing machinery and the opportunity to study computing techniques are available in the School's Health Sciences Computing Facility. Please refer to page 44 for a complete description of the Computing Facility. Teletype terminals are provided for interactive use with various time-sharing systems.

Any course in the Department is open to any student who meets the prerequisites stated in the course description.

Biostatistics 101a,b. Principles of Biostatistics

Lectures. *Two one-hour sessions each week, first and second periods.*

Laboratory. *One three-hour session each week, first and second periods.*
Staff of the Department.

Credit 3.5 units.

Lectures and laboratory exercises acquaint the student with demographic concepts, the nature and composition of rates and their uses in administration and epidemiology. The theory of measurements and distributions including estimation, tests of significance, and interaction are discussed. Basic concepts of probability and association, sampling techniques and study design are introduced.

Biostatistics 202c,d. Statistical Methods in Research

Lectures, discussions and laboratory. *Two three-hour sessions each week, third and fourth periods.* Dr. WORCESTER, Dr. DROLETTE, and Dr. WARRAM.

Credit 5 units.

This course, a continuation of Biostatistics 101a,b, introduces the student to technical statistical procedures important in problems of laboratory and field research. Topics included are further considerations of probability and correlation, together with an introduction to procedures used in the planning of experiments, including variance analysis, non-parametric methods, dosage response and maximum likelihood.

Prerequisites: Basic preparation in statistics and epidemiology.

Biostatistics 203c,d. Mathematical Foundations of Biostatistics

Lectures. *One two-hour session each week, third and fourth periods. Time to be arranged.* Dr. DROLETTE.

Credit 2.5 units.

The material covered includes mathematical descriptions of commonly used distributions, standard procedures for estimating the moments of a distribution and mathematical foundations of statistical inference, including the Neyman-Pearson lemma, the likelihood ratio, the central limit theorem, power and Bayesian influence.

Prerequisite: A course in elementary calculus.

Epidemiology and Biostatistics 204b,c,d. Design and Analysis of Epidemiologic Investigations: Applications

Tutorials and seminars. *One two-hour seminar each week second, third, and fourth periods.* Dr. ROTHMAN and Dr. MIETTINEN.

Credit 2.5 or 5 units

(Course is described under Department of Epidemiology)

Epidemiology and Biostatistics 205c,d. Topics in Epidemiologic Research

Seminars. *One two-hour session each week, third and fourth periods.* Dr.

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MACMAHON and Staffs of the Departments of Epidemiology and Biostatistics.

Credit 2.5 units.

(Course is described under Department of Epidemiology)

Biostatistics 207c,d. Survey Research Methods in Community Health

Lectures and discussions. *Two one-hour sessions each week, third and fourth periods.* Dr. FELDMAN.

Credit 2.5 units.

Research design, sample selection, questionnaire construction, interviewing techniques, the reduction and interpretation of data, and related facets of population survey investigations are covered. The course is focused primarily on the application of survey methods to problems of health program planning and evaluation. The treatment of methodology is sufficiently broad to be suitable for students who are concerned with applications to epidemiological, nutritional or other types of survey research.

Biostatistics 210c,d. Advanced Topics in Biostatistics

Seminar. *One two-hour session each week, third and fourth periods.* Dr. BISHOP.

Credit 2.5 units.

The subject matter of this course varies from year to year. During the year 1973-74, Biostatistics 210c,d will concentrate upon practical applications of multivariate statistical methods.

The course is intended primarily for students specializing in Biostatistics. Other students may be admitted by obtaining the consent of the Department.

Biostatistics 213e. Introduction to Computing

One full week is offered twice a year, one-week period between Fall and Spring terms and week following Spring term. Staff of the Health Sciences Computing Facility.

Credit 1 unit.

Lecture and laboratory exercises provide an opportunity to learn fundamental procedures in the processing of data with computers. Laboratory exercises are conducted using equipment in the Health Sciences Computing Facility.

Biostatistics and Health Services Administration 216c,d. Health Program Evaluation

Seminars and Tutorials. *One two-hour seminar in first week of third period; weekly tutorial group meetings for remainder of third period; one two-hour seminar each week, fourth period.* Mr. FRAZIER, Dr. DENSEN, Dr. FELDMAN, Mrs. JONES and Dr. REED.

Credit 2.5 units.

This course is designed for students interested in the evaluation of on-going health programs. After an introduction to the literature on evaluation methods, students are assigned to groups, each of which designs an evaluation proposal for a specific health program. During the fourth period seminars, these proposals are presented and critically analyzed by the students.

Biostatistics 310-315a,b,c,d. Tutorial Programs

Time and credit to be arranged. Staff of the Department.

An opportunity for tutorial work at the Master's level is offered for interested and qualified students or small groups of students. Arrangements must be made with individual faculty members and are limited by the amount of faculty time available. These tutorial programs are open to students specializing in Biostatistics and also to students in other fields who wish to go beyond the content of the regular courses. Six broad categories of this tutorial instruction are identified by the six course numbers below.

310 *Tutorial in Statistical Methods.*

Guided study in specific areas of statistical methodology and application.

311 *Tutorial in Teaching.*

Work with the Department in laboratory instruction and the development of teaching materials.

312 *Tutorial in Consultation.*

Work with members of the Department on current statistical consultation activities.

313 *Tutorial in Computing.*

Guided study in scientific programming, numerical methods and data management.

314 *Tutorial in Study Design.*

Guidance in developing statistical design of a study in which the student has a particular interest.

315 *Tutorial in Data Analysis.*

Guidance in the statistical analysis of a body of data in which the student is interested.

Biostatistics 350. Research

Candidates for the Doctors of Public Health, Doctor of Science or other doctoral degrees may arrange for individual research. The work may be part of the program for a doctorate in this Department or may be integrated with doctoral research in other departments.

Students may register for Biostatistics 310-315 for a maximum of ten credit units in the summer term.

Environmental Health Interdepartmental Courses

The following courses are conducted by the Faculty and Staff of The Kresge Center for Environmental Health, which includes the Departments of Environmental Health Sciences, Physiology, and Sanitary Engineering.

Environmental Health Interdepartmental 201a,b. Principles of Environmental Health

Lectures, discussions, and tours. *Two one-hour sessions and one two-hour session each week, first and second periods.* Dr. MOELLER and Staff of the Center.

Credit 4 units.

Some of the more important environmental health problems facing society are reviewed. Topics presented through lectures, discussions, and case studies include community air pollution, occupational health, electromagnetic radiation, noise and other physical stresses, water purification and wastewater treatment, basic sanitation, solid-waste management, toxicology, and land-use planning.

Environmental Health Interdepartmental 202c,d. Community Environmental Health Management — A Computerized Game (Social Sciences 142)

Lectures, discussions, and role playing. *One one-hour and one three-hour session each week, third and fourth periods.* Dr. MOELLER, Dr. SPENGLER and Staff of the School of Public Health.

Credit 5 units.

This is a computerized game which simulates a metropolitan environment by including basic data on such factors as air pollution characteristics, employment, land use, and public services. By playing such roles as air pollution control officers, politicians, town planners, industrialists, and land developers, students are given the opportunity to make decisions on issues raised by the community.

Enrollment is limited to 60 students.

Environmental Health Interdepartmental 203a,b,c,d. Principles of Aerospace Health and Safety

Seminars. *One two-hour session each week, first, second, third and fourth periods.*

Credit 5 units.

Not given in 1973-74.

Principles of aerospace medicine are presented as they affect health and per-

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formance of individuals exposed to physical, chemical and biological stress. Established associations between environmental stress and harmful effects are compared to accepted safe limits for human tolerance.

Prerequisite: Physiology 203a,b, or equivalent.

Enrollment is subject to the approval of the Instructor.

Environmental Health Interdepartmental 204c,d. Human Factors in Occupational Performance and Safety

Lectures and demonstrations. *One two-hour session each week, third and fourth periods.*

Credit 2 units.

Not given in 1973-74.

Ways are examined to improve occupational performance and safety through the applications of human factors engineering, or biotechnology. A multi-disciplinary approach is employed, drawing upon experimental psychology, applied physiology, and physical anthropology as they are related to the design of the task, the work space, and the working environment.

Environmental Health Interdepartmental 206c,d. Occupational Medical Clinics

Clinics, Massachusetts General Hospital. *One two-hour session each week, third and fourth periods.* Dr. PETERS and Dr. MURPHY.

Credit 2 units.

These clinics are concerned with occupational diseases, such as silicosis, beryllium intoxication, coal miner's pneumoconiosis, and lead poisoning. Special clinics are held in ophthalmology and dermatology.

The clinics are limited to physicians and are not offered if less than four students enroll.

Environmental Health Interdepartmental 207c,d. Occupational Medicine

Lectures and seminars. *One two-hour session each week, third period; two two-hour sessions each week, fourth period.* Dr. PETERS, Dr. WILKINS, and Dr. TYLER.

Credit 3 units.

This course considers the traditional administration and organization of occupational medical departments, federal, state and municipal programs in occupational health, and how current legislation may affect them. The worker's view of occupational health and safety is also presented.

This course will be limited to physicians and will not be offered if less than four enroll.

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Environmental Health Interdepartmental 208a,b. Operations Research in Environmental Health Engineering

Lectures and computer exercises. *Three hours each week, first and second periods; time to be arranged.* Dr. HARRINGTON.

Credit 3 units.

Not given in 1973-74.

This is an introduction to the concepts and techniques of operations research, applied to problems of environmental health sciences and engineering. Topics include several interrelated mathematical techniques of optimization — Lagrangian methods, steepest descent, linear, nonlinear and dynamic programming, approximation theory; systems analysis of air and water treatment and solid waste disposal practices; applications of queueing theory, Markov processes, and statistical decision theory.

Prerequisite: Mathematics 20b (differential equations), or equivalent.

Enrollment is subject to the approval of the Instructor.

Environmental Health Interdepartmental 209c,d. Mathematical Modelling for Health Sciences

Lectures and discussions. *Three one-hour sessions each week, third period; two two-hour sessions, fourth period.* Dr. DAWSON.

Credit 4 units.

General principles of modelling are taught and applied to the health sciences, including population theory, ecology, physiology, and environmental control.

Prerequisite: elementary calculus.

Environmental Health Interdepartmental 330e. Field Work

Credit 1 unit.

A week of supervised field observation is offered during the one-week period between Fall and Spring terms. Students may choose appropriate visits to medical or industrial hygiene departments of industries, airports, and other agencies which have operations or research in the field of environmental health.

Department of Environmental Health Sciences

DADE W. MOELLER, S.B., S.M., PH.D., A.M. (hon.), Professor of Engineering in Environmental Health, Head of the Department *and* Associate Director, Kresge Center for Environmental Health

Faculty: Professor First; Associate Professors Burgess, Dennis, Goldin, Mahoney and Wilkins; Assistant Professors Hinds, Spengler and Underhill; Lecturers Bjarngard, Cudworth, Shapiro and Webster

Because of the growing public awareness of the need for environmental pollution control and worker protection, an increasing amount of attention is being focused on these problems at all levels of our society. At the Harvard School of Public Health, research and training have been conducted on these subjects since 1926. Applicable curricula offered by the Department of Environmental Health Sciences include Air Pollution Control, Radiological Health, and Industrial Hygiene. These programs are open to engineers, physicians, and other professional personnel with undergraduate backgrounds in physics, chemistry, and biology.

Graduate training in each of the fields covered by the Department includes courses on human physiology, epidemiology and biostatistics. Typical courses selected as electives in the several options may be as follows:

Air Pollution Control

Community Air Pollution (Environmental Health Sciences 261a,b)

Meteorological Aspects of Air Pollution (Environmental Health Sciences 262a,b)

Identification and Measurement of Air Contaminants (Environmental Health Sciences 264c,d)

Air and Gas Cleaning (Environmental Health Sciences 265c,d)

Aerosol Technology (Environmental Health Sciences 253a,b)

Principles of Toxicology (Physiology 205c, 205d)

Industrial Hygiene

Basic Problems in Occupational Health and Industrial Environments (Environmental Health Sciences 251c,d)

Environmental Control (Environmental Health Sciences 252c, 252d)

Environmental Physiology (Physiology 204c)

Identification and Measurement of Air Contaminants (Environmental Health Sciences 264c,d)

Air and Gas Cleaning (Environmental Health Sciences 265c,d)

Principles of Toxicology (Physiology 205c, 205d)

Aerosol Technology (Environmental Health Sciences 253a,b)

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Radiological Health

Introduction to Radiation Protection (Environmental Health Sciences 271a,b)

Radiation Biology (Physiology 207c,d)

Radiation Protection Engineering (Environmental Health Sciences, 272a,b)

X-ray Protection (Environmental Health Sciences 274c,d)

Aerosol Technology (Environmental Health Sciences 253a,b)

Problems in Radiation Dosimetry (Environmental Health Sciences 273c,d)

Supporting the teaching program are extensive research activities. Current studies include an evaluation of performance factors for respirators and gas masks, assessment of the environmental impact of nuclear facilities, medical radiation applications and dosimetry, the design of cleanup systems for radioactive sodium aerosols, the application of gas- and liquid-phase reactions to particulate and gas removal, a numerical study of urban scale atmospheric transport, the monitoring of worker stresses by telemetered physiological measurements, and an investigation of the population dose from radiation of natural origin. Supporting these studies are related cooperative research projects conducted by the Departments of Physiology and Epidemiology. As a result, students have many excellent opportunities for research, either on an independent basis or as a participant in an ongoing project.

As may be noted, some of the courses in this Department carry "Engineering" numbers. These are cross listed in the catalog of the Division of Engineering and Applied Physics in Cambridge and provide course credit through that Division as well as the School of Public Health.

Environmental Health Sciences 202a,b,c,d. Departmental Seminar

Seminars. *One one-hour session each week, first, second, third and fourth periods.* Staff of the Department.

Credit 2 units.

The purpose of these seminars is to supplement the formal course work of the Department by bringing to the attention of students a wide range of topics of contemporary interest in air pollution control, industrial hygiene, and radiological health. Discussion leaders include faculty members from the Kresge Center, students from the Department, and specialists from industrial, governmental, and university research centers.

Environmental Health Sciences 251c,d. Basic Problems in Occupational Health and Industrial Environments (Engineering 282)

Lectures. *Two two-hour sessions each week, third and fourth periods.*

Laboratory demonstrations and field trips. *One three-hour session each week, third and fourth periods.* Dr. FERRIS, Dr. FIRST, Dr. PETERS, and Mr. BURGESS.

Credit 5 units.

Lectures, laboratory demonstrations and inspections of work places show the relation of working conditions to health with special reference to control of industrial hazards. Examples include adverse conditions of temperature, humidity, radiation, and chemical and physical irritants. Particular emphasis is given to the prevention, diagnosis, and treatment of industrial disability and disease, and to workmen's compensation.

Prerequisite: Physiology 203a,b.

Environmental Health Sciences 252c, 252d. Environmental Control (Engineering 280)

Lectures. *Two one-hour sessions each week, third and fourth periods.*

Laboratory. *One three-hour session each week, third and fourth periods.* Mr. BURGESS and Dr. CUDWORTH.

Credit 2.5 units in each period.

Will not be given in 1973-74.

The first half of this course centers on the design and evaluation of industrial ventilation systems for the control of toxic contaminants released to the workplace through industrial operations and processes. The second half is designed for environmental health specialists responsible for evaluation and control of noise hazards. Topics include measurements and instrumentation, and specific control approaches for production equipment.

Environmental Health Sciences 253a,b. Aerosol Technology (Engineering 286)

Lectures. *Two one-hour sessions each week, first and second periods.*

Laboratory. *One two-hour session each week, first period; one four-hour session each week, second period.* Staff of the Department.

Credit 5 units.

This course deals with the properties of particulate clouds and the physical principles underlying their behavior, including aerosol measurement. Topics include individual particle trajectories, diffusion, condensation and evaporation, electrical and optical properties, and coagulation, as well as the behavior of the cloud *in toto*.

Environmental Health Sciences 261a,b. Community Air Pollution*

Lectures, demonstrations, and seminars. *One two-hour session each week, first and second periods.* Dr. FIRST and Staff of the Center.

Credit 2.5 units.

This course is designed for engineers, chemists, and physicians interested in air pollution control. Topics presented include the measurement and control

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of community air pollution; air quality standards; health effects of air pollution; damage to animals, plants and property; community and site surveys; the legal and enforcement aspects of air pollution control; and the nature and quantity of atmospheric emissions from transportation vehicles, municipal incinerators and specific industries.

Environmental Health Sciences 262a,b. Meteorological Aspects of Air Pollution*

Lectures and demonstrations. *One two-hour session each week, first and second periods.* Dr. MAHONEY and Dr. SPENGLER.

Credit 2.5 units.

This course presents an evaluation of the meteorological factors associated with the transport of air pollutants. Topics include properties of the atmosphere near the ground, turbulent dispersion of air pollutants, atmospheric diffusion equations, diffusion from single and area sources, mathematical models for evaluating urban air pollution, and instrumentation for evaluating the movement and behavior of air pollutants.

Enrollment is subject to the approval of the Instructor.

Environmental Health Sciences 264c,d. Identification and Measurement of Air Contaminants (Engineering 283)

Lectures. *Two one-hour sessions each week, third and fourth periods.*

Laboratory. *One three-hour session each week, third and fourth periods.* Dr. UNDERHILL and Staff of the Department.

Credit 5 units.

This course emphasizes sampling and analytical methods for air contaminants plus related subjects. Included are chemical and instrumental methods of air analysis, isokinetic sampling, biological and solvent analysis, radioactive aerosol determinations, air pollution surveys, and fire and explosion evaluations. The course is recommended for students in Industrial Hygiene and Air Pollution Control and suggested for students in the Radiological Health and the Master of Industrial Health Programs.

Environmental Health Sciences 265c,d. Air and Gas Cleaning

Lectures. *One two-hour session each week, third and fourth periods.*

Laboratory. *One two-hour session each week, third and fourth periods.* Dr. FIRST and Staff of the Department.

Credit 5 units.

This course covers theory, selection, application, and testing of air and gas cleaning devices, including gas absorption in liquids and adsorption on solids, gas incineration, particle collection by inertial and centrifugal force,

* These two courses constitute Engineering 284.

basic processes of particle conditioning. Laboratory experiments and case studies illustrate important aspects of sizing and correct selection of equipment.

Prerequisites: Environmental Health Sciences 253a,b, and Environmental Health Sciences 264c,d. (May be taken simultaneously.)

Environmental Health Sciences 271a,b. Introduction to Radiation Protection (Engineering 288)

Lectures. *Two one-hour sessions each week, first and second periods.*

Laboratory and field trips. *One three-hour session each week, first and second periods.* Dr. GOLDIN.

Credit 5 units.

This course presents the elements of radioactivity; interaction of radiation with matter; methods for radiation protection; radiation protection standards and the major sources of population exposure. Work includes assigned readings on radiation protection guides and the public health implications of radiation uses. Laboratory exercises provide an introduction to measurement and safe use of radiation sources.

Environmental Health Sciences 272a,b. Radiation Protection Engineering (Engineering 287)

Lectures. *Two two-hour sessions each week, first and second periods.* Dr. SHAPIRO.

Credit 5 units.

This course covers the basic physical principles, mathematical analyses, and engineering methods utilized in the evaluation and control of radiation hazards. The material is developed through consideration of radiation protection problems of nuclear power reactors, radiation-producing machines, and radiochemical laboratories. Topics covered include: neutron slowing and diffusion; nuclear reactor theory; criticality safeguards; radiation shielding; in-plant radiation protection; and analysis of environmental hazards.

Enrollment is subject to the approval of the Instructor.

Environmental Health Sciences 273c,d. Problems in Radiation Dosimetry

Lectures. *Two one-hour sessions each week, third and fourth periods.*

Laboratory, *One three-hour session each week, third period.* Dr. SHAPIRO.

Credit 4 units.

This course deals with the experimental and theoretical methods of evaluating radiation fields and determining radiation dose rates. Special dosimetry problems for study in the laboratory are selected from the fields of health physics, nuclear engineering, and nuclear medicine.

Prerequisite: Environmental Health Sciences 271a,b.

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Environmental Health Sciences 274c,d. X-ray Protection

Lectures. *One two-hour session each week, third and fourth periods.*

Laboratory. *One four-hour session each week, third and fourth periods.*
Time to be arranged. Dr. WEBSTER.

Credit 5 units.

Will not be given in 1973-74.

This course covers the fundamentals of X-ray equipment (both industrial and medical), the design of X-ray installations, and procedures for radiation protection surveys and inspections and includes several problem assignments. Considerations include both equipment and room design with emphasis on items such as leakage, collimation, filtration, primary and secondary barriers, workload, and protection of patients.

Environmental Health Sciences 276c,d. Physics in Diagnostic Radiology

Lectures. *One two-hour and one one-hour sessions each week, third and fourth periods.*

Laboratory. *One three-hour session each week, third and fourth periods.*
Dr. WEBSTER.

Credit 5 units.

This course is designed to familiarize students with the theory and application of the technical equipment used in diagnostic radiology. The major emphasis is on the physical and mathematical aspects of the process of image formation. Topics include characteristics of diagnostic X-ray machines and recording systems, geometrical relationships, X-ray spectra, information limits, optical physiology and performance, special physical techniques, and radiation protection.

Enrollment is subject to the approval of the Instructor.

Environmental Health Sciences 277a,b. Physics in Radiation Therapy

Lectures. *One two-hour and one one-hour sessions each week, first and second periods.*

Laboratory. *One three-hour session each week, first and second periods.*
Dr. BJARNGARD

Credit 5 units.

This course provides the student with didactic training and practical experience in treatment planning, machine performance control, and other aspects of physics in radiation therapy. Pertinent measurement techniques are stressed, with particular emphasis on accurate and precise dosimetry. Treatment planning for irradiation by external beams, by brachytherapy, and by radioactive nuclides, with and without computer assistance, is included.

Enrollment is subject to the approval of the Instructor.

Environmental Health Sciences 278a,b. Physics in Nuclear Medicine

Lectures. *One two-hour and one one-hour sessions each week, first and second periods.*

Laboratory. *One three-hour session each week, first and second periods.* Dr. BJARNGARD and Mr. ZIMMERMAN.

Credit 5 units.

Not given in 1973-74.

This course is designed to familiarize students with the theory and practice of utilization of radionuclides in medical diagnosis. Topics covered include the production, properties, and standardization of radionuclides and radio-pharmaceuticals; instrumentation, including scanners, cameras, and collimators; dynamic studies; tracer kinetics; and dose calculations. Computer applications and radiation protection are included.

Enrollment is subject to the approval of the Instructor.

Environmental Health Sciences 301-305a,b,c,d,e. Tutorial Programs

Reading or Research. *Time and credit to be arranged.*

Reading or research assignments for individual tutorial work at a Master's degree level are provided for qualified students in the fields of industrial hygiene, industrial ventilation, aerosol technology, radiological hygiene, medical radiation physics, nuclear medicine, solid waste management and air pollution control.

301 *Air Pollution*, Dr. FIRST and Dr. MAHONEY.

302 *Industrial Hygiene*, Mr. BURGESS.

303 *Radiological Health*, Dr. GOLDIN, Dr. MOELLER and Dr. SHAPIRO.

304 *Medical Physics*, Dr. BJARNGARD and Dr. WEBSTER.

305 *Solid Wastes*, Dr. FIRST.

Enrollment is subject to the approval of the Head of the Department.

Environmental Health Sciences 350-359. Research

Facilities of the Department are available for doctoral candidates and properly qualified second-year master's degree students to pursue independent research on problems in industrial hygiene, aerosol technology, solid waste management, air pollution control and radiological health. Areas currently receiving study in the Department are as follows:

351 Evaluation of performance factors of respiratory protective devices; monitoring exposures of occupational groups to toxic air contaminants; ventilation control of airborne contaminants; evaluation and control of noise (Mr. Burgess).

352 Application of gas- and liquid-phase reactions to particulate and gas removal; development and design of cleanup systems for airborne contaminants from industrial and nuclear power plant facilities; incineration of solid

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wastes including municipal, radioactive, biological and laboratory materials (Dr. First).

353 Measurement and control of environmental radiation; application of radiation and radioactive materials to environmental health problems; radiation safety in the use of nuclear energy (Dr. Goldin).

354 Computer modelling of pollutant transport in urban atmospheres; analysis of air quality data derived from sampling networks; meteorology of urban areas (Dr. Mahoney and Dr. Spengler).

355 Reduction of population dose from sources of natural origin; environmental protection for nuclear facilities; radiation safety criteria and standards (Dr. Moeller).

356 Sampling and analysis of aerosol particles both in the ambient atmosphere and under laboratory conditions; generation of monodisperse aerosols; uses of aerosols in environmental health; development of particulate removal equipment (Dr. Hinds).

357 Evaluation and control of hazards from radioactive contamination; dosimetry of radiation from high energy accelerators (Dr. Shapiro).

358 Medical radiation physics with emphasis on dosimetry, nuclear medicine and radiation therapy (Dr. Bjarngard).

359 Medical radiation physics with emphasis on survey techniques, instrumentation, and image quality and patient dose reduction in diagnostic radiology (Dr. Webster).

Enrollment is subject to the approval of the Head of the Department.

Department of Epidemiology

BRIAN MACMAHON, M.B., CH.B., D.P.H., PH.D., S.M. IN HYG., M.D., Professor of Epidemiology and Head of the Department

Faculty: Professors Hutchison and Worcester; Associate Professors Braun, Cole, Miettinen, Monson and Segall; Assistant Professors Mack and Rothman

The major objective of the Department of Epidemiology is to provide opportunities for training and experience in the application of epidemiologic research methods to the investigation of diseases of unknown etiology. Emphasis is on the cardiovascular and mental disorders, the malignant neoplasms, abnormalities of reproduction and development, and other major diseases for which preventive measures are still unknown or inadequate.

A one-year research-training program leads to the degree of Master of Science in Epidemiology. This program includes most of the courses listed below, except for Epidemiology 202c which is intended for students whose primary interest is something other than epidemiology, plus Biostatistics 101a,b, 202c,d, and 213e—a total of between 25 and 30 credit units. The remainder of the credits required for the degree may be taken as additional formal courses in areas of special interest, or as supervised research (Epidemiology 300a,b,c,d).

For qualified students the period of research training may be extended by admission to either of the doctoral programs offered by the School, by admission to special student status, or through other individual arrangements. Most of the training period beyond the master's degree is occupied in supervised research experience. Potential doctoral candidates must plan at least two years in residence beyond completion of the master's degree.

A three-year residency in the Department of Epidemiology has been approved as satisfying residency requirements of the American Board of Preventive Medicine for certification in General Preventive Medicine. Requirements of the approved residency and of the School's degree programs may be satisfied simultaneously.

Epidemiology 201a. Principles of Epidemiology

Lectures, laboratories, and seminars. *Two two-hour sessions each week, first period.* Dr. MONSON and Dr. MACK.

Credit 2.5 units.

Lectures, laboratory work and seminars on the purposes, principles and methods of epidemiology, defined as the study of the distribution and

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determinants of disease frequency in man. The principles discussed serve as an introduction to many aspects of the prevention and control of disease in populations. Illustrations include classic and contemporary studies of acute and chronic disease.

Epidemiology 202c. Epidemiologic Workshop

Seminars. *One two-hour session each week, third period.* Dr. MACK and Dr. MONSON.

Credit 1 unit.

This course is for non-epidemiologists who intend to apply epidemiologic principles in their fields. Participants will select topics and design studies testing useful hypotheses. These studies will be discussed in class by faculty and students. Emphasis will be placed on simple rather than complex study designs and analyses.

Prerequisites: Epidemiology 201a and Biostatistics 101a,b, or equivalent.

Epidemiology 203b. Design and Analysis of Epidemiologic Studies: Principles

Lectures. *Two two-hour sessions each week, second period.* Dr. MIETTINEN and Dr. ROTHMAN.

Credit 2.5 units.

With the focus on etiologic and intervention studies, the course covers the topics of problem conceptualization, study characterization, general design, foundations of validity and efficiency, control of confounding and analysis of data.

Prerequisites: Epidemiology 201a and Biostatistics 101a,b, or equivalent.

Epidemiology and Biostatistics 204b,c,d. Design and Analysis of Epidemiologic Investigations: Applications

Tutorials and seminars. *One two-hour seminar each week, second, third, and fourth periods.* Dr. ROTHMAN and Dr. MIETTINEN.

Credit 2.5 or 5 units.

The seminars consist of student presentations of study plans and epidemiologic data analyses, with discussion by students and faculty. Preparatory work is done under tutorial arrangements with members of the faculty. For the analyses, the emphasis will be on conceptual issues and not on execution.

Prerequisites: for 5 credits, enrollment in Epidemiology 203b; for 2.5 credits, Epidemiology 201a, or equivalent.

Epidemiology and Biostatistics 205c,d. Topics in Epidemiologic Research

Seminars. *One two-hour session each week, third and fourth periods.* Dr. MACMAHON and Staffs of the Departments of Epidemiology and Biostatistics.

Credit 2.5 units.

This course is intended for students who expect to be professionally involved in epidemiologic research, particularly in chronic diseases. Seminars on diverse topics will include patient and population sampling; factors affecting response and data handling; methods of analysis of time-place clustering, cyclic variation and survival; and the problems of distinguishing genetic and environmental disease components.

Prerequisites: Epidemiology 201a and Biostatistics 101a,b, or equivalent.

Tropical Public Health, Microbiology, and Epidemiology 206d. Tuberculosis

Seminars. *One two-hour session each week, fourth period.* Dr. MORROW, Dr. MACK, Dr. BERGGREN and Dr. MULL.

Credit 1 unit.

(Course is described under Department of Tropical Public Health)

Epidemiology 211c,d. Epidemiology of Chronic Disease

Lectures. *One two-hour session each week, third and fourth periods.* Dr. HUTCHISON.

Credit 2.5 units.

This course presents a review of the present knowledge of the frequency, distribution and determinants of selected diseases. Diseases are selected on the basis of public health importance, availability of substantial epidemiologic literature, or special timeliness. Included are cardiovascular diseases, malignancy, diabetes, chronic respiratory disease, congenital malformations, arthritis, peptic ulcer, glaucoma, suicide, and mental disease.

Epidemiology 212c,d. Biology and Epidemiology of Cancer

Lectures. *Two one-hour sessions each week, third and fourth periods.* Dr. COLE.

Credit 2.5 units.

A systematic overview of virus, chemical and physical carcinogenesis, and tumor biology and immunology is presented. The major malignant diseases are then reviewed, primarily from the epidemiologic point of view. Emphasis is placed on presentation of available and foreseeable methods of prevention and early disease detection. Effort is made to integrate information from the relevant disciplines, especially in the review of specific diseases.

Epidemiology 213d. Epidemiology of Oral Diseases

Seminars. *One two-hour session each week, fourth period.* Dr. ROTHMAN.

Credit 1 unit.

This course is intended for dentists with an interest in dental epidemiology,

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including surveys and clinical trials. The epidemiology of oral diseases is reviewed, and methodologic problems intrinsic to dental research are discussed. Participants are invited, but not required, to present an original study design for critical review. Topics to be covered include dental caries, periodontal diseases, oral cancer, malocclusion, and indices of oral health.

Epidemiology, Microbiology, and Tropical Public Health 214c,d. Case Studies in Epidemiology of Infectious Disease

Seminars and laboratory exercises. *One two-hour session each week, third and fourth periods.* Dr. MACK, Dr. MORROW, Dr. LANGMUIR and Dr. NICHOLS.

Credit 2.5 units.

This course deals with problems in the epidemiology of communicable and other acute diseases. In each session a case study is taken from an actual epidemic or other acute disease control situation, and the student is asked to assume the role of investigator and control officer.

Epidemiology 300a,b,c,d,e. Tutorial Programs

Participation in departmental research in close association with a staff member. Time and credit are to be arranged with the Head of the Department.

Epidemiology 350. Research

In selecting topics for research in doctoral programs, students should consider the fields in which members of the Department are currently working.

These include:

Neoplastic disease (Dr. MACMAHON, Dr. COLE, Dr. MACK, Dr. MONSON)

Congenital malformation (Dr. MACMAHON, Dr. MIETTINEN, Dr. YEN)

Cardiovascular disease (Dr. SEGALL, Dr. MIETTINEN)

Dental disease (Dr. ROTHMAN)

Statistical methods (Dr. MIETTINEN, Dr. VENEZIAN)

Department of Health Services Administration

ALONZO S. YERBY, S.B., M.D., M.P.H., Professor of Health Services Administration, Head of the Department

Faculty: Professors Curran, Densen, Frechette and Young; Associate Professors Berry and Simmons; Assistant Professors Fineberg, Neuhauser and Wilson; Senior Lecturer Yankauer; Lecturers Giddon, Kasten and Yacovone

Our contemporary health systems are in a dynamic state of change. Increasingly, health is considered to be a basic human right. Government is more and more being thrust into the health field, for the benefit of both the individual and the community. The increasing complexity of medical services calls for diverse types of health organizations. The growth of organized health services has created an increased need for qualified administrators and researchers.

A major goal of the Department of Health Services Administration is to provide education for leadership in health service organizations. Emphasis is placed on planning, organization, evaluation and regulation of health services. Efforts are made to adapt relevant theory and concepts from the social and behavioral sciences—including such fields as economics, law, political science, anthropology, sociology, and public and business administration—to the practical problems of providing health services.

Special attention is given to macro-administration or the administration of health systems. Cross-national studies of health care systems are used as analytic tools to assist the student in gaining an appreciation of the universal nature of the determinants that govern organized activity for the delivery of health services.

Consideration is given to traditional administrative techniques as well as more recently developed quantitative and analytic methods. Since many problems, broad in scope, must be studied, the resources of multiple disciplines and several Harvard faculties are carefully integrated into the program.

The program leads to the degree of Master of Public Health or Master of Science in the field of Health Services Administration. Candidates for the degree program are expected to demonstrate competence in their own professional discipline and an understanding of quantitative methods and their application to the planning, administration and evaluation of health services. A minimum of four courses offered or approved by the Department satisfies the Departmental program requirements. The remainder of the credits required for the degree may be taken as additional formal courses, tutorials or supervised research in areas of special interest to the candidate.

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Qualified students interested in research training may seek admission to either of the doctoral programs offered by the School. During the first year of provisional doctoral candidacy, students are expected to enroll in advanced courses in health services administration and related fields. However, most of the training period beyond the master's degree is occupied by the completion of a research project and the preparation of a thesis. Doctoral candidates must plan at least two years in residence beyond completion of the master's degree.

A two-year program in health services administration is offered for college graduates with strong academic preparation in the biological or social sciences, who wish to prepare themselves for a management career in health services. The aim is to provide the student with the requisite factual knowledge, conceptual framework, and administrative skills for line or staff positions within a variety of health service organizations, government agencies, and health-related institutions.

The program emphasizes qualitative and quantitative techniques that have proven useful in the analysis of complex problems, the formulation of policy alternatives, the effective integration of diverse bodies of specialized knowledge for decision-making purposes, and the translation of problem-solving capability into skilled managerial performance in diverse administrative and political settings. Attention is directed both to the micro-administrative scale of executive action in hospitals, health centers, and government agencies, and to the macro-administrative scale of leadership that influences the actions of interacting sets of organizations and institutions operating in community, regional, and societal environments.

The program makes use of courses offered at Harvard University in the graduate schools of Business Administration, Education, Government, Law, Medicine, and Public Health. Selected courses at the Massachusetts Institute of Technology are also included in the curriculum. A six-week, supervised work experience in a health service agency or program during the intermediate summer, or part-time field placement of equivalent time (240 hours) during the second year of the program, is required.

Health Services Administration 201a,b. The Nature and Function of Health Care Delivery Systems

Lectures and discussions. *Two two-hour sessions each week, first and second period.* Dr. YERBY and Staff of the Department.

Credit 4 units.

This course consists of an analysis of health care systems and their component institutional forms as they have evolved as expressions of the felt needs of societies. The evolution, structure and function of health care systems as they are currently expressed in selected nations, and the universality of the forces that serve to shape and mold them will be examined.

Health Services Administration 202b,c,d. Departmental Seminar

Seminars. *One two-hour session each week, second, third and fourth periods.* Dr. YERBY and Staff of the Department.

Credit 3 units.

This course is for persons concentrating in the Department. It will be focused on current issues in health services administration.

Health Services Administration 203a,b. Administration and Organization of Health Services

Lectures and discussions. *Two two-hour sessions each week, first and second periods.* Dr. NEUHAUSER and Staff of the Department.

Credit 4 units.

The character and functions of the administrative process in health organizations. The focus is upon: organizational and environmental factors that shape and constrain the administrative process, decision-making, and techniques of administrative control.

Maternal and Child Health and Health Services Administration 204a. Welfare Programs and Their Relation to Health

Seminars. *One two-hour session each week, first period.* Dr. SCHMIDT, Dr. YERBY and Staffs of the two Departments.

Credit 1 unit.

(Course is described under Department of Maternal and Child Health.)

Health Services Administration 205a,b; 205c,d. Health Education

Seminars. *One two-hour session each week, first and second periods.* Dr. YOUNG and Dr. SIMMONS.

Credit 2 units.

This course is designed primarily for program administrators and emphasizes major aspects of learning theory, communication theory, educational methods, and health behavior; health education in the process of social change; psychosocial and cultural factors relevant to planning of health education programs; and research and evaluation in health education.

The above course is repeated in c,d period.

Health Services Administration 206c,d. Health Law, Public Policy, and Consumer Protection in the Health Field

Seminars. *One two-hour session each week, third and fourth periods.* Dr. CURRAN

Credit 2 units.

Application of law and legislative process to the establishment of public policy

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in health fields such as medical care delivery systems, health manpower, and consumer protection. Special attention is given to regulation of quality in health care, consumer involvement and equality of access to health systems. A case analysis method is employed.

Health Services Administration 207a,b. Dental Public Health Practice

Seminars and field visits. *One two-hour session each week, first and second periods.* Dr. YACOVONE.

Credit 2 units.

This seminar provides in-depth training in the administration and planning of dental health programs. Subjects covered include: community needs, resources, surveying, fluoridation, prepayment, and program evaluation. Each student develops a program plan in a specific area of community dental needs and presents the plan to the class.

Health Services Administration 208c,d. The Economics of Health Services and Health Planning

Lectures and discussion. *Two one and one-half hour sessions each week, third and fourth periods.* Dr. BERRY.

Credit 4 units.

This course is designed to provide an examination of the economic aspects of the production, distribution, and organization of health services. The course is devoted to applying the framework of economic analysis to the health services sector. Topics normally covered include the supply and demand of medical care facilities, markets for health manpower, financing of medical care, cost-benefit analysis, and problems of health planning.

Prerequisite: Interdepartmental 210a,b or its equivalent.

Health Services Administration 211c,d. Administration of Personal Health Service Programs

Seminars and field projects. *One two-hour session each week, third and fourth periods.* Dr. KASTEN.

Credit 2 units.

The course is designed for students who will be administrators of personal health service programs. Inpatient, ambulatory, home and rehabilitation programs are treated from an operational and preventive perspective. Special emphasis is placed on administrative problem solving. Students analyze administrative problems in operating personal care service programs.

Health Services Administration 213c,d. Politics and Organization of Health Planning

Seminars. *One two-hour session each week, third and fourth periods.*

Credit 2 units.

Not Given in 1973-74.

Analysis and explication of the operating characteristics and effectiveness of the principal types of health planning agencies, such as comprehensive health planning agencies. A major objective is to consider how the effectiveness of planning agencies and planning personnel can be increased. The focus is upon: theories of community planning; community decision-making processes; the effect of community variables and their organizational characteristics on the performance of planning agencies; and strategies of effective planning.

Health Services Administration 214c,d. Methods for the Efficient Management of Health Services Organizations

Seminars. *One two-hour session each week, third and fourth periods.*
Dr. NEUHAUSER.

Credit 3 units.

This course describes management techniques such as budgets, information systems, measurement of efficient utilization, matrix organizations, decision analysis etc., and shows how they can be applied to hospital operating characteristics like occupancy, average length of stay, size, scope of services, which in turn affect efficiency and quality of care. Readings review research literature, and short problems are used to elicit class discussion; a paper is required.

Health Services Administration 215c; 215d. An Introduction to Ambulatory Care Administration

Seminars. *One two-hour session each week, third and fourth periods.* Dr. WILSON.

Credit 1 unit in each period.

This course deals with the concepts, problems and issues involved in administering ambulatory care programs, including organization, operations, professional and non-professional staffing, and the concept of the health care team. Comparative models such as neighborhood health centers and group practice are discussed.

Prerequisite: Health Services Administration 203a,b or permission of the Instructor.

Biostatistics and Health Services Administration 216c,d. Health Program Evaluation

Seminars and Tutorials. *One two-hour seminar in first week of third period; weekly tutorial group meetings for remainder of third period; one*

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two-hour seminar each week, fourth period. Mr. FRAZIER, Dr. DENSEN, Dr. FELDMAN, Mrs. JONES, and Dr. REED.

Credit 2.5 units.

(Course is described under Department of Biostatistics.)

Health Services Administration 219b, 219c. Delivery of Urban Health Services

Seminars. One one and one-half hour session per week, second and third periods. Dr. NEUHAUSER.

Credit 1 unit in each period.

This seminar covers problems and solutions, successes and failures in the delivery of urban health services. Topics include outreach clinics, community participation, financing, the role of state and federal government, urban hospitals, drug programs, medical schools, and personnel. Newly developed teaching cases will be used and a different case will be discussed each week. Each week the student is required to read a case, analyze the problem and discuss it in class. Either period may be taken separately.

Health Services Administration 295a,b. Economics of Health Care Policy (Economics 2950a)

Seminars. One two-hour session each week, first and second periods. Dr. FEIN.

Credit 3 units.

This interdisciplinary course surveys health care policy issues from the perspective of economics. Among topics discussed are: health manpower issues, medical care financing programs including government insurance, medical care organization issues, the Federal health budget, cost-benefit analysis. Interdepartmental 210a,b or its equivalent will normally be sufficient to prepare students for this course. Each student is expected to prepare a term paper.

Health Services Administration 295c,d. Economic and Administrative Issues in Medical Care (Economics 2950b)

Seminars. One two-hour session each week, third and fourth periods. Dr. BERRY, and Dr. PETERSON.

Credit 4 units.

This seminar is concerned with the major issues of the medical care sector. During the first half of the course specific attention is given to issues of access to services, quality of care, and costs and inflation in the health sector. Alternative health care systems and planning are also considered. During the second half of the course student groups present their analysis of a

specific significant issue in health or medical care. Throughout the course there is an emphasis on policy analysis.

Health Services Administration 300a,b,c,d,e. Tutorial Programs.

Time and credit to be arranged.

Master's degree candidates may make arrangements to do individual and group work under the guidance of a staff member of the Department.

This work can include readings and special projects in such areas as dental health, medical care, and health education. In addition, field assignments to federal, state, and local government and private health organizations can be arranged.

302 *Research in Health Education*, Dr. YOUNG and Dr. SIMMONS

This tutorial aims to assist doctoral students and others interested in research methodology in health education to understand the elements of research design and to apply these elements in analyzing a number of research projects and in developing original research proposals. Special emphasis is given to evaluation research.

303 *Dentistry and Social Policy*, Dr. YACOVONE

This tutorial presented in the third and fourth periods, investigates relationships between the social sciences and dentistry. Subjects considered include the role of the social sciences in dentistry, psychosocial interaction of doctor and patient, client perceptions of dentistry, interpersonal relationships in group practice, and the sociopolitical influence of dentistry as an organization.

Health Services Administration 304c,d. Decision Analysis (Offered in Fall Term at Kennedy School of Government, Public Policy 211)

A self-paced, self-instructional, multi-media course on decision analysis. The course consists of 11 modules. Professor HOWARD RAIFFA (Faculty of Public Administration).

Credit 5 units.

The course involves structuring of decision problems in terms of decision trees; use of information to revise probabilistic judgments; economic value of information; decisions concerning accumulation of evidence; attitudes towards risk; art and science of assessing distributions of uncertain quantities; use of panels of experts; analysis of complex problems from business, medicine, law, public policy; simulation and Monte Carlo techniques; structuring of values, goals, and objectives; value tradeoffs; discounting and problems of futurity; risk-sharing; group decisions.

Health Services Administration 330e. Assignments to Field Agencies

One-week period between Fall and Spring Terms.

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Credit 1 unit.

Students are assigned to work on special projects, such as group surveys, other types of field projects, or observation of and limited participation in the work of health agencies. Field assignments are made on an individual basis to meet the special needs of each student insofar as possible. Work in the field is coordinated with courses in the Department.

Health Services Administration 350. Research

Doctoral candidates are offered the opportunity of undertaking individual study and research as the basis for a doctoral thesis.

Department of Maternal and Child Health

WILLIAM M. SCHMIDT, S.B., M.D., A.M. (hon.), Professor of Maternal and Child Health and Head of the Department

Faculty: Associate Professor Valadian and Assistant Professor Dwyer.

The Department of Maternal and Child Health is concerned with education and research in health services for mothers and children as a part of general health services and as they relate to other service systems (especially social services and education). The planning for the delivery of personal health, social, and family planning services to mothers and children depends upon knowledge of:

1. the aspirational values which society places upon them, their special vulnerability to biological and environmental hazards, and the successive phases of biological change (growth and development);
2. the social situation and the way in which social services function as they affect the health of children and influence the child-care capability of families;
3. the health aspects of centers of early childhood education, and traditional and innovative practices in elementary and high schools.

The courses and tutorial work offered by the Department are focused on actions which these characteristics demand for planning, administration, and evaluation of health care services. Maternal and Child Health services, including services for handicapped children, at international, national, and local levels, are discussed in terms of integration with related health services in the community. In connection with this Departmental focus, the important roles of national governments, local health agencies, voluntary organizations, and community consumer groups are considered in seminars, observations of service programs in operation, or study of reports of such programs, foreign as well as domestic.

Fellowships are available for students who are concentrating in Maternal and Child Health.

Maternal and Child Health 101. Child Growth and Development

Self instruction course. Can be taken any period. Dr. VALADIAN.

Credit 2.5 units.

Individualized instruction in the physical growth, development, and maturation of children is presented in self-paced programmed material, supple-

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mented as needed by conferences. The course covers topics which are necessary for advanced study of growth and development and which are basic for students who plan to be involved in medical or related social and educational services for children.

Maternal and Child Health 202b. Primary Maternal and Child Health Care

Seminars and field visits. *One two-hour session each week, second period.* Dr. VALADIAN and Staff of the Department.

Credit 1 unit.

Seminars and field observations focus on four different health centers in Boston. Faculty members participate in the visits and seminars which are intended to relate the observed activities to maternal and child health and to crippled children's programs.

Maternal and Child Health 203c,d. Programs in Maternal and Child Health

Seminars. *Two two-hour sessions each week, third and fourth periods.* Dr. SCHMIDT, Dr. VALADIAN, and Staff of the Department.

Credit 4 units.

Beginning with planning for children, successive segments of the course include maternity, early childhood, later childhood, and adolescence and youth, to demonstrate how the health needs of families change with the age periods of children. Seminars deal with programs, legislative developments and research. Also included are field visits and student presentations based upon assigned readings.

Maternal and Child Health and Health Services Administration 204a. Welfare Programs and Their Relation to Health

Seminars. *One two-hour session each week, first period.* Dr. SCHMIDT, Dr. YERBY and Staffs of the two Departments.

Credit 1 unit.

Public policy in relation to health and welfare is reviewed. The course focuses on the U.S. system of income maintenance with respect to effectiveness, attitudes underlying its provisions and alternatives. The course also deals with child welfare services with respect to their effectiveness in meeting the needs of children and families and their relationship to health care.

Maternal and Child Health 205d. Research Approach to Growth, Development and Health of the Child

Seminars. *Two two-hour sessions each week, fourth period.* Dr. VALADIAN and Dr. REED.

Credit 2 units.

Methods of obtaining and evaluating data on child growth, development, and health, and the construction of norms are studied, including the design of studies dealing with interrelationships among various aspects of the child's progress, background, and environment.

Enrollment is subject to the approval of the Instructor.

Maternal and Child Health 206c. Adolescence and Youth: Sociological Concepts Related to Health Care

Lectures and seminars. *One two-hour session each week, third period.* Staff of the Department.

Credit 1 unit.

Not given in 1973-74.

This multi-disciplined approach to adolescent and youth behavior in the United States includes a review of social science research on socialization practices, adolescent culture, and adolescent problems, including health problems. Early familial influences on youth are analyzed with respect to health care, health attitudes, and child-rearing practices. The relationship of the structure of society to growth and development is considered.

Maternal and Child Health and Nutrition 207a,b. Nutrition in Child Growth and Development

Lectures and discussions. *One two-hour session each week, first and second periods.* Dr. DWYER and Visiting Lecturers.

Credit 2.5 units.

Principles and practical problems encountered in the nutritional aspects in child growth and development are examined. Lectures on general principles are designed to help students base their judgments on scientific evidence. Discussions deal with a variety of nutrition case studies and simulations illustrative of problems in both developing and highly industrialized countries.

Maternal and Child Health 300b,c,d,e. Tutorial Programs

Time to be arranged.

Credit 2 or more units.

Students may arrange to undertake an individual project or specialized reading under faculty supervision. Possible topics include: planning and evaluating health care services for mothers and children; public health nursing in family and community health programs; technical assistance to developing countries in maternal and child health. Advance approval by the Head of the Department is required.

Maternal and Child Health 330. Field Study

1. *One-week period between Fall and Spring terms.*

Credit 1 unit.

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Field study is available at: 1) Puerto Rico (in cooperation with the Department of Human Development, School of Public Health, University of Puerto Rico) to observe regionalized programs in maternal and child health, for handicapped children, and in family planning; and 2) Boone, North Carolina (in cooperation with Appalachian State University) to observe rural health programs for mothers and children. Enrollment is limited and requires approval of the Head of the Department *before the end of the first period*.

Additional Field Study

Students who lack sufficient previous experience are encouraged to undertake a period of field study before registration or after completion of the academic year, in a program arranged by the Staff of the Department. No credit.

Maternal and Child Health 350. Research

Doctoral degree students may undertake research in Maternal and Child Health by arrangement with the Head of the Department.

Department of Microbiology

ROGER L. NICHOLS, A.B., M.D., A.M. (hon.), Irene Heinz Given Professor of Microbiology, Head of the Department, *and* Associate Director of the Center for the Prevention of Infectious Diseases

Faculty: Professors Murray and Snyder; Associate Professors Sanford and Vinson; Assistant Professors Buckley, Cerny, Essex, Fraser, MacDonald, Modabber, Morse and Mull; Lecturer Madoff

Infectious diseases remain a major health problem, costing the United States billions of dollars each year; in underdeveloped countries these diseases impede progress. Microbiologists must now be concerned not only with prevention and treatment but with policy formation, administration and research if the problems of infectious disease, domestic and foreign, are to be solved. One of the goals of the Department of Microbiology, in conjunction with the Department of Tropical Public Health in the Center for Prevention of Infectious Diseases, is to provide this education for leadership in control of infectious diseases. Emphasis is placed on the decision making processes involved in diagnostic and surveillance programs; in judging the uses and limitations of public health systems, domestic and foreign, in the control of infectious disease; and in study of fundamental microbiological and immunological problems in infectious diseases of public health significance. The multifactorial causation of infectious diseases is emphasized in teaching and is related to the changing political, social and economic patterns in developed and underdeveloped countries which impinge upon the dynamics of the microbe-host relationship.

A major objective of the Department is to train students to think of infectious diseases in the context of epidemiology. Advances in immunology have extended the scope of inquiry required of microbiologists to autoimmune disorders, hypersensitivity phenomena, variations in host responses, cancer and immunological surveillance mechanisms.

Candidates for the degree of Master of Public Health or Master of Science in Microbiology must demonstrate competence in microbiology and immunology; they must understand the problems and opportunities in the control of infectious disease in developed as well as underdeveloped countries. A minimum of four courses offered or approved by the Department will satisfy this requirement. The remainder of the credits required for the degree may be taken as additional formal courses, tutorials, or supervised research in areas of special interest to the candidate.

Qualified students interested in research training may be admitted to

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either the Doctor of Public Health or the Doctor of Science programs offered by the School in the Department of Microbiology. During the first year of a provisional doctoral candidacy, students are expected to enroll in advanced courses in microbiology, immunology and related fields in the School of Public Health, in the Harvard Medical School or in other areas of Harvard University or the Massachusetts Institute of Technology. Doctoral candidates must plan at least one year in residence beyond completion of the Master's degree. Most of the training beyond the Master's degree is occupied by completion of a research project and preparation of a thesis. Applied aspects of research are emphasized.

The Department maintains close liaison with Harvard Medical School and with several hospitals affiliated with Harvard University. Thus to the School of Public Health's interest and expertise in preventive and surveillance programs, community-wide or global in scope, are added the resources of medical education and university hospitals which emphasize the fundamental aspects of microbiology, immunology and the individual care of the patient.

Tropical Public Health and Microbiology 201a,b. Ecology and Epidemiology of Infectious Diseases

Lectures, seminars, and laboratory exercises. *Three one-hour sessions and one three-hour session each week, first period; one one-hour and two two-hour sessions each week, second period.* Dr. WELLER, Dr. NICHOLS, and Staffs of the two Departments.

Credit 4 units.

(Course is described under Department of Tropical Public Health.)

Microbiology and Tropical Public Health 202b. Current Research in Infectious Diseases

Seminars. *One two-hour session each week, second period.* Dr. CHERNIN, Dr. VINSON, and Staffs of the Departments of Microbiology and Tropical Public Health.

Credit 1 unit.

This course is required of all students concentrating in Microbiology or Tropical Public Health. Papers on topics of general interest are selected from current periodicals and critically reviewed as to soundness of experimental design, validity and significance of results and conclusions, organization of manuscripts and clarity of presentation.

Enrollment of nondepartmental students subject to approval of Instructor.

Microbiology 203d. Clinical Problems in Infectious Diseases

Lectures and clinics. *One two-hour session each week, fourth period.* Dr. MULL.

Credit 1 unit.

Problem cases concerning diagnosis, treatment and control of the common acute communicable diseases of temperate climates are presented.

Microbiology 204c. Public Health and Laboratory Aspects of Infectious Diseases of Microbial Origin

Seminars and laboratory exercises. *Two three-hour sessions and one one-hour session each week, third period.* Dr. MURRAY and Dr. MORSE.

Credit 2.5 units.

Primary orientation is toward the immunologist. Students perform in detail cultural, immunological and biochemical techniques, e.g., toxin assays, immunofluorescence, complement fixation and neutralization tests. Viruses, bacteria and rickettsiae are inoculated into embryonated eggs, tissue culture and animals.

Tropical Public Health, Microbiology, and Epidemiology, 206d. Tuberculosis

Seminars. *One two-hour session each week, fourth period.* Dr. MORROW, Dr. MACK, Dr. BERGGREN and Dr. MULL.

Credit 1 unit.

(Course is described under Department of Tropical Public Health.)

Microbiology 207a. Fundamentals of Immunology

Lectures. *Three one-hour sessions each week, first period.* Dr. MACDONALD, Dr. CERNY and Dr. MODABBER.

Credit 2.5 units.

This course explores the fundamental principles of immunology and host defense mechanisms. Many aspects of immunology will be studied including humoral and cellular phenomena.

The course is intended to allow those individuals with no previous exposure to the field to become acquainted with essential principles; it will serve as a review for those wishing to expand their knowledge of immunology or reappraise their attitudes in a burgeoning field.

Microbiology 208b. Immunology of Infectious Diseases

Lectures and laboratory exercises. *Two one-hour sessions each week, second period. Laboratory exercises to be arranged.* Dr. MACDONALD, Dr. MULL, Dr. CERNY, Dr. FRASER and Dr. ESSEX.

Credit 2.5 units.

A number of diseases are selected for discussion from an immunological point of view, and their host defense mechanisms are studied. Examples include: immunology of mucosal surface infections such as gonorrhea, trachoma or cholera; pathogenesis of antigen-antibody complexes in streptococcal infec-

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tions; immunology of malaria, cancer and tuberculosis; problems associated with mycotic infections, and host defense mechanisms to smallpox and measles.

Prerequisite: Microbiology 207a or equivalent.

Microbiology 209b. Laboratory in Immunology

Laboratory. *Two three-hour sessions per week, second period.* Dr. MACDONALD, Dr. CERNY and Dr. MODABBER.

Credit 2.5 units.

The laboratory consists primarily of recently developed techniques, which can be utilized in the study of infectious diseases. These techniques will include isolation and modification of antigens, radio-immunoassay, immuno-plaque assay, isolation of antibodies, fluorescence labelling, immunoabsorption, phagocytosis, migration inhibition factor, blast transformation, virus neutralization and complement fixation.

Prerequisite: Microbiology 207a or equivalent.

Enrollment limited; prior approval of Instructor is required.

Microbiology 211b. Medical Mycology

Laboratory, conferences and field exercises. *One three-hour session and three hours of individual laboratory work each week, second period.* Dr. BUCKLEY.

Credit 2 units.

This course introduces physicians and microbiologists to laboratory and field research and to clinical studies in medical mycology. No prior knowledge of the mycoses is assumed.

Enrollment is subject to the approval of the Instructor.

Microbiology 213d. Intracellular Microorganisms Pathogenic for Man

Laboratory exercises and seminars. *Two three-hour sessions each week, fourth period.* Dr. MURRAY, Dr. VINSON and Dr. FRASER.

Credit 2 units.

This course provides an understanding of the techniques available for studying the growth and the characteristics of representative strains of rickettsiae, chlamydia, and viruses which are human pathogens. Under staff supervision, each student performs the procedures for identification and characterization of unknown pathogens.

Prerequisite: Microbiology 204c or equivalent.

Enrollment is limited to ten students with prior approval of the Instructor.

Epidemiology, Microbiology, and Tropical Public Health 214c,d. Case Studies in Epidemiology of Infectious Disease

Seminars and laboratory exercises. *One two-hour session each week, third and fourth periods.* Dr. MACK, Dr. MORROW, Dr. LANGMUIR and Dr. NICHOLS.

Credit 2 units.

(Course is described under Department of Epidemiology.)

Microbiology 215d. Problems in Medical Bacteriology

Seminars and laboratory demonstrations. *One three-hour session each week, fourth period.* Dr. BUCKLEY and Dr. MORSE.

Credit 1 unit.

Bacteriologic problems of particular interest to students, which were not considered in Tropical Public Health-Microbiology 201a,b, are discussed. Course content is assembled around the students' interests. The course is given only if the instructor receives at least six individual requests before the end of the second quarter.

Microbiology 216c. Sexually Transmitted Diseases

Lectures and Seminars. *One two-hour session each week, third period. Additional time and credit may be arranged.* Dr. VINSON, Dr. MULL and Guest Lecturers.

Credit 1 unit.

Discussion centers on why sexually transmitted diseases that are easily cured are out of control. Reviewed topics include pathobiologic, epidemiologic, and biosocial aspects of venereal diseases, such as patterns of sexual behavior, lay and professional attitudes toward V.D. and patients, and legal and economic aspects of control. Interaction of students from both social and medical sciences benefits the examination of possible new approaches for dealing with the problems.

Microbiology 300a,b,c,d. Tutorial Programs

Time and credit to be arranged. Staff of the Department.

Enrollment requires the consent of the staff member responsible for supervision of the research. The various subject areas are listed below by category.

301 *Pathogenic Fungi*, Dr. BUCKLEY.

Immunological characterization of the antigenic mosaic of *Candida* and *Cryptococcus spp* and other "opportunistic" fungi in compromised patients.

302 *Rickettsiae*, Dr. MURRAY and Dr. VINSON.

The biology, immunology, and epidemiology of typhus, Rocky Mountain spotted fever, scrub typhus, and trench fever may be studied in the laboratory or in field operations in Yugoslavia, Tunisia, Mexico, and Cape Cod, Mass. Biologic systems include infected animals, chick embryos, cell cultures, human body lice and oriental rat fleas. Immunology embraces immunoglobulin

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and cell mediated immune responses, antigenic analyses of rickettsiae as well as logic procedures and vaccines.

303 *Chlamydia*, Dr. MURRAY, Dr. NICHOLS, Dr. MACDONALD and Dr. MULL.

Laboratory and field research in trachoma, inclusion conjunctivitis, psittacosis, lymphogranuloma venereum and the diseases caused by the chlamydial agents in humans and animals. Students are welcome to do laboratory and occasionally field investigations.

304 *Viruses*, Dr. MURRAY, Dr. ESSEX, Dr. FRASER, and Dr. MORSE.

Isolation and identification of representative viruses by use of cell culture, animal inoculation, and serologic techniques.

305 *Immunochemical Methods*, Dr. MACDONALD and Dr. MODABBER.

Experiments with immunofluorescence, chromatography, immunoelectrophoresis, ultracentrifugation, labelled isotopes and other techniques applied to research on microorganisms and mechanisms of hypersensitivity.

306 *Public Health Laboratory*, Associates at the State Laboratory Institute.

The State Laboratory Institute is engaged in a variety of programs related to public health. These include the development, preparation, and testing of new and standard serums, vaccines, and blood fractions; research in various aspects of applied immunology; various aspects of diagnostic service in the fields of bacteriology, virology, and congenital metabolic disorders; and field studies on arboviruses. Individual arrangements for study can be made in any of these programs.

307 *Tumor Biology*. Dr. ESSEX and Dr. CERNY.

Approaches and techniques for the study of cancer as an infectious disease. Procedures used to study tumor cell and tumor virus marker antigens and antibodies are demonstrated. The significance of these markers for epidemiological, etiological, and diagnostic investigations of various tumor systems of known and unknown cause is discussed. The relationship between the immune response and the oncogenic process is also examined.

308 *Cellular Immunology*. Dr. CERNY, Dr. ESSEX and Dr. MODABBER.

Differentiation of cells producing antibody of various classes *in vivo* and *in vitro*. The studies involve the use of a number of immunological methods, but principally the agar plaque technique. The major experimental model utilized is immune response to cell wall antigens of *Vibrio cholerae*. The research also involves experiments on interaction between antibody forming cells and leukemic viruses in mice and studies on mechanism of virus-induced immunosuppression.

309 *Susceptibility to Infectious Disease*, Dr. MULL.

Directed reading on the broad subject of susceptibility to infectious disease. Emphasis is on malnutrition and relevant immunodeficiency syndromes. Field work is possible by arrangement.

310 *Venereal Diseases*. Dr. NICHOLS, Dr. MURRAY, Dr. VINSON, Dr. MORSE and Dr. MULL.

The departmental research on venereal diseases, especially gonorrhea, and the chlamydial diseases spans biology, immunology, microbial physiology and epidemiology. Student participation in ongoing project areas is encouraged.

311 *Disease Control in Underdeveloped Countries*. Dr. NICHOLS.

Specific problems of underdeveloped countries in planning for improvement in health care are studied with emphasis on infectious disease control. The tutorial is intended to be practical.

Microbiology 350. Research

Qualified doctoral candidates, research fellows, and full-time special students may register for Microbiology 350 to undertake original research in virology, rickettsiology, mycology, bacteriology, immunology, or in one of the disciplines available at the State Laboratory Institute. A number of the current research activities of the Department of Microbiology are indicated under 300. Inquiries about specific research opportunities should be addressed to the Head of the Department.

Department of Nutrition

FREDRICK J. STARE, S.B., S.M., PH.D., M.D., A.M. (hon.), S.D. (hon.), D.SC. (hon.),
Professor of Nutrition and Head of the Department

Faculty: Professors Geyer, Hegsted and Mayer; Associate Professors Antoniades, Gershoff, Herrera-Acena, Kerr and Lown; Assistant Professors Austin, Cohen, Dwyer, Hayes, Thenen and Westmoreland

The Department of Nutrition is concerned with basic and applied investigations in the science of nutrition in the areas of biochemistry, physiology, pathology, and psychology. Many of these are oriented toward problems of contemporary public health importance, such as cardiovascular diseases, obesity, and osteoporosis. The Department also has programs dealing with general nutritional and health problems in various countries in South America, Africa, and Asia.

In addition to the courses available in the School of Public Health, students may take graduate courses in the other Schools of Harvard University and at the Massachusetts Institute of Technology. Thus, a program leading to the Doctor of Science degree might include courses in nutrition, biochemistry, biostatistics and epidemiology, physiology, and bacteriology, as well as advanced courses in these and related fields, such as organic and physical chemistry and biology. Appropriate programs are available at the doctoral level for individuals whose interests lie in community nutrition rather than in laboratory nutrition and biochemistry.

Candidates for the Master of Public Health degree who elect to concentrate in Nutrition are normally expected to take the following courses in addition to satisfying the formal course requirements for the degree:

Nutrition 201a, 201b and at least one other course offered by the Department of Nutrition.

Nutrition 201a, 201b. Public Health Nutrition

Lectures. *One two-hour session each week, first and second periods.* Dr. MAYER and Dr. GERSHOFF.

Credit 1 unit in each period.

The course deals with human nutrition and the application of nutrition programs to public health. The "a" period is concerned with nutrition problems in industrialized countries, such as obesity, nutrition and cardiovascular disease, food safety, and nutrition programs in the United States. The "b" period is concerned with nutrition problems of developing countries, such as

nutritional deficiency diseases, famine, assessment of nutritional status, and the relationship of food and nutrition programs to socioeconomic development.

Nutrition 202b,c,d. Departmental Seminar

Seminars. *Two one-hour sessions each week, second, third and fourth periods.* Dr. THENEN and Dr. WESTMORELAND.

Credit 3 units.

Students are expected to summarize and criticize recent publications on assigned topics in nutrition. Attention is placed on validity of experimental designs in nutritional research. Topics include the biochemical, physiological, psychological, and sociological aspects of nutrition.

Nutrition 203a,b,c,d. Advanced Topics in Nutrition

Lectures, discussions and required reading. *Two two-hour sessions each week, first, second, third and fourth periods.* Dr. HAYES, and Staff of the Department.

Credit 10 units.

The biochemical and clinical aspects of the metabolism of carbohydrates, fats, proteins, vitamins, and essential minerals are considered in detail with students actively participating in presentation and discussion of the material. The course is intended for students majoring in nutrition but may be taken by others with consent of the Instructors.

Nutrition 204c,d. Laboratory and Animal Research Techniques

Lectures and demonstrations. *One three-hour session plus two additional hours each week, third and fourth periods.* Dr. GEYER, Dr. ANTONIADES and Staff of the Department.

Credit 5 units. Students not majoring in Nutrition may elect fewer hours with a commensurate decrease in credit units.

By means of discussions, laboratory work, and tutorial instruction this course affords the opportunity to learn the principles and practice of modern experimental animal and laboratory research techniques. The schedule is so arranged as to allow the student to simultaneously participate in a variety of ongoing research projects involving animals and/or mammalian cell cultures, and to conduct instrumental and non-instrumental laboratory procedures.

Nutrition 206c,d. Nutritional Aspects of Human Disease

Lectures, discussions and demonstrations. *One two-hour session each week, third and fourth periods.* Dr. KERR and Staff of the Department.

Credit 2 units.

This course reviews the role of specific nutrients in the causation and therapy of such clinical diseases as coronary heart disease, dental caries, anemia, alco-

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holism, renal disease, specific diets, malabsorptive states, diabetes mellitus, trauma, and wound healing. In addition to considerations of the primary care of individuals with these disorders, emphasis is placed on public health concepts of education, prevention, and early detection of nutrition-related diseases.

Maternal and Child Health and Nutrition 207a,b. Nutrition in Child Growth and Development

Lectures and discussions. *One two-hour session each week, first and second periods.* Dr. DWYER and Visiting Lecturers.

Credit 2.5 units.

(Course is described under Department of Maternal and Child Health.)

Nutrition 300a,b,c,d,e. Tutorial Programs

Time and credit to be arranged.

Individual work, under direction, may be arranged for students at the master's level. This may include laboratory studies or projects in applied nutrition.

Nutrition 350. Research

Time and credit to be arranged.

Facilities are available for students at the doctoral level to do advanced work in nutrition along the lines of fundamental research or applied nutrition in public health and medicine. Areas currently receiving intensive and comprehensive study in the Department are as follows:

The effect of nutrition and other environmental factors on the etiology of heart disease in man; nutrition education; fluoride in human nutrition as a preventive for tooth decay and osteoporosis; cooperative international researches in nutrition. (Dr. STARE)

The nutritive value of proteins and protein requirements; dietary effects on the metabolism of cholesterol in animals and man; the influence of diet on the metabolism of adipose tissue; nutritional requirements for calcium and for bone formation. (Dr. HEGSTED)

Neurophysiological, behavioral, and metabolic aspects of the regulation of food intake in animals; experimental obesity; anthropological, metabolic, and behavioral studies of obesity in children and adolescents; psychological aspects of nutrition in man. (Dr. MAYER)

Lipid metabolism in tissue culture cells; polyvalent metal metabolism in soft tissue; effects of CO₂ deprivation on tissue culture cells, parenteral nutrition and artificial blood substitutes. (Dr. GEYER)

The effects of nutritional deficiencies on endocrine metabolism; the etiology

of urolithiasis in experimental animals and man; vitamin metabolism; interrelationships between nutrition and endocrine function. (Dr. GERSHOFF)

Coronary artery disease; etiology of sudden death; derangements of the heart beat; exercise physiology; electrolyte metabolism. (Dr. LOWN)

Protein isolation and characterization; hormone biochemistry and metabolism. (Dr. ANTONIADES)

Endocrine, nutritional, and metabolic aspects of diabetes and hyperlipidemia. Mental development and learning capacity as affected by malnutrition. (Dr. HERRERA-ACENA)

Lipid metabolism in human platelets; energy substrate metabolism related to the problem of platelet preservation. (Dr. COHEN)

Investigation of certain psychological factors affecting obesity, dieting, and weight control efforts, relationships between nutrition knowledge and various groups and their eating practices; evaluation of feeding programs. (Dr. DWYER)

Nutritional pathology and the fat-soluble vitamins with specific interest in lipid metabolism, atherosclerosis, and metabolic bone disease. (Dr. HAYES)

Primatology, particularly nutrition as it relates to fetal development. (Dr. KERR)

Biochemistry of folic acid and vitamin B₁₂ in relation to hemopoiesis or central nervous system function. Metabolic aspects of genetic obesities in animals. (Dr. THENEN)

Electron microscopic morphology and histochemistry of atherosclerosis, smooth muscle cells in tissue culture, arterial connective tissue and blood thrombi produced by the injection of Factor XIIa. (Dr. WESTMORELAND)

Admission is limited and is subject to the approval of the Instructor.

Department of Physiology

JAMES L. WHITTENBERGER, S.B., M.D., A.M., (hon.), James Stevens Simmons
Professor of Public Health, Professor of Physiology and Head of the Department

Faculty: Professors Ferris and Mead; Associate Professors Amdur, Brain, Leith, Little, McGandy, Murphy, S., and Peters; Assistant Professors Dawson, Hoppin, Jaeger, Murphy, R., Sorokin, Underhill and Williams

The Department of Physiology has interests which include physiology as a basic medical science. The Department's concerns, however, extend beyond pure physiology to encompass a broad spectrum of environmental health problems for which physiologic and biochemical knowledge and techniques are necessary tools. The biologic effects of air pollutants, of pesticides, and of radiation are typical problems that have been central to the Department's interests. Such broad problems require the insights of many specialties and the personnel of the Department reflect this multi-disciplinary approach. The staff of the Department includes physicians, physiologists, health and safety specialists, engineers, toxicologists, and specialists in radiobiology, occupational and aerospace medicine. Students and Research Fellows come with similarly varied backgrounds.

A major objective of the Department is to provide students with basic information on the relationship of man to his physical and chemical environment. The course, Environmental Health Interdepartmental 201a,b, introduces M.P.H. candidates to fundamental concepts regarding the measurement of both the quality of the environment and its impact on man. These concepts are examined in detail in specialized courses such as Environmental Physiology, Principles of Toxicology, and Radiation Biology. Specific research projects of members of the Department offer students an opportunity to gain experience in, and to develop a capacity for, critical evaluation of research methods. Qualified individuals may enroll in a program leading to a doctoral degree.

The research programs include topics such as cellular effects of ionizing radiation, mechanisms of carcinogenesis and mutagenesis, toxic interactions of particles and vapors, inhalation toxicology, pesticide metabolism and toxicity, enzyme induction, comparative respiratory physiology, and the deposition and clearance of particles in the respiratory tract. Other research areas are the mechanical properties of lungs and chest wall, including mathematical modeling, mechanisms of flow limitation, development of pulmonary function tests and testing equipment.

Physiology 203a,b. Human Physiology

Lectures and conferences. *Two two-hour sessions each week, first and second periods.*

Laboratory and demonstrations. *One two-hour session each week, first and second periods.* Dr. LEITH and Staff of the Department.

Credit 5 units.

Students lacking a background in biology are offered an intensive introduction to cell, organ, and organism physiology, including structure, genetics and reproduction, endocrinology, neuromuscular, circulatory and respiratory physiology, and fluid and solute exchange. Correlated laboratory exercises give experience with living systems.

Prerequisites: College courses in physics, chemistry, and mathematics, or permission of the Instructor.

Physiology 204c. Environmental Physiology

Lectures and conferences. *One two-hour session each week, third period.* Dr. LEITH and Staff of the Department.

Credit 1 unit.

This course deals with limits and limiting mechanisms of responses, adaptation, performance and tolerance of living organisms under stresses imposed by their physical, chemical, and biological environments. Exercise, altitude and diving, high and low temperatures and humidities, and other topics are included. Course content and structure are flexible.

Prerequisite: Master of Science candidates who wish to take this course must have had Physiology 203a,b or the equivalent.

Physiology 205c, 205d. Principles of Toxicology

Lectures and laboratory demonstrations. *Two two-hour sessions each week, third and fourth periods.* Dr. AMDUR, Dr. MURPHY and Dr. JAEGER.

Credit 2.5 units in each period.

This course deals with injurious effects of exposure to foreign chemicals. The "c" period deals with history, methods and basic principles of toxicology and mechanisms of chemical injury to cells, organ systems and intact animals. The "d" period deals with toxicological problem areas in public health, e.g., air pollution, pesticides, metals. Required of students offering a major or minor in toxicology. The "d" period may be taken separately with permission of Instructors.

Prerequisites: College chemistry, biology and physiology.

Physiology 207c,d. Radiation Biology

Lectures. *Three one-hour sessions each week, third and fourth periods.*

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Laboratory. *One two-hour session each week, third and fourth periods.* Dr. LITTLE.

Credit 5 units.

This course is divided into two parts: cellular and mammalian radiobiology. The first includes target theory, radiation chemistry, cellular and chromosomal effects, UV-photobiology, and cellular and molecular repair processes. The second part covers the acute and long-term effects of radiation in man, as well as the characteristics of internal and external human exposure. The biologic basis of the acute radiation syndrome, and the human epidemiologic data for radiation carcinogenesis are emphasized.

Prerequisite: Physiology 203a,b, or equivalent. The lectures (3 credit units) may be taken without the laboratory with consent of the Instructor. The laboratory will not be offered for less than 5 students.

Physiology 208a,b. Seminar in Toxicology

Lectures and seminars. *One two-hour session each week, first and second periods.* Dr. MURPHY, Dr. AMDUR and Dr. JAEGER.

Credit 2 units.

The objective is to provide more in-depth discussion of selected problems in toxicology than is provided in 205c,d. Discussions led by staff, students and guest speakers deal with basic mechanisms of action of toxic chemicals, as well as applied topics, such as epidemiological and legislative matters. Topics vary from year to year. Students majoring in toxicology are expected to register each year. Students who wish to offer toxicology as an area for doctoral examinations should register for at least one year.

Enrollment is subject to the approval of the Instructor.

Physiology 209a,b. Molecular and Cellular Processes in Radiobiology

Lectures. *One two-hour session each week, first and second periods.*

Laboratory. *Individual work to be arranged.* Dr. WILLIAMS.

Credit 5 units.

The effects of radiations on mammalian cells in culture are studied in detail with special emphasis on hit and target theory analysis, nucleic acid metabolism, synergism and antagonism with physical and chemical agents at the molecular level, and the role of molecular repair in survival. Students are given original problems in radiobiology to solve using cultured mammalian cells.

Prerequisite: Physiology 207c,d or permission of the Instructor.

Physiology 300. Tutorial Programs

Time and credit to be arranged.

Opportunities are provided for tutorial work at a master's degree level in the fields of respiratory physiology, toxicology, occupational medicine, and radiobiology.

Physiology 350. Research

Doctoral candidates and other properly qualified students may undertake laboratory or field research by arrangement with the Head of the Department.

Department of Population Sciences

NATHAN KEYFITZ, B.S.C., PH.D., Andelot Professor of Sociology in the Faculty of Arts and Sciences and of Demography in the Faculty of Public Health; Acting Head of the Department

Faculty: Professors Dyck, Revelle, Salhanick, Snyder and Thomas; Associate Professor Berggren; Assistant Professors McIntosh and Pullum; Senior Lecturer Wyon; Lecturer Plank

The advances of the past century in science, technology, and economic development have revealed unprecedented opportunities for improving the quality of life for much of mankind. Among these opportunities are several in the field of public health which have been the basis for large-scale programs aimed at prevention and control of major diseases, such as malaria and smallpox. But the striking successes in reducing morbidity and mortality from epidemic diseases have not been consistently accompanied by improvement in the conditions of life. Rapid expansion of population in many parts of the world is thwarting the current efforts to provide better housing, education, nutrition, health services and medical care. The disparity between rates of population increase and rates of development of human and economic resources is a crucial problem confronting society.

Acting under the conviction that the health professions can and should participate in general efforts to improve the quality of human life, the School of Public Health established the Department of Demography and Human Ecology in 1962 (renamed the Department of Population Sciences in 1969) and the Center for Population Studies in 1964.

The formal courses and the tutorial instruction of the Department are planned to prepare students for effective participation in population programs as administrators, research workers, or educators. The Department has developed courses of instruction in the biological and social processes which influence population change, in the means available to control human fertility, and in the physiology of reproduction.

The courses of instruction listed below are those intended primarily for students enrolled in the School of Public Health, but may be elected by students in other parts of Harvard or by other qualified persons who fulfil the criteria for admission as special students.

Candidates for the degree of Master of Science in Population Sciences should direct inquiries concerning their programs to the Head of the Department.

Candidates for the Master of Public Health degree who elect to concentrate

in Population Sciences are encouraged to take most of the following courses:

Population Sciences 200a,b; Population Sciences 202c,d; Population Sciences 203c,d; Population Sciences 204c,d; Population Sciences 205c,d; Population Sciences 207c,d; and Population Sciences 330e.

Population Sciences 185a,b. Applied Mathematical Demography (Sociology 185)

Lectures. *Two one and one-half hour sessions each week, first and second periods.* Dr. KEYFITZ and Dr. PULLUM.

Credit 5 units.

Probabilities of survival and of childbearing; the general one-sex model and the stable special case; parity and interbirth intervals; cohorts and periods; extension to two sexes and to changing rates of birth and death. Application to population prediction, inferring birth rates from censuses, occupational mobility, migration, kinship, effects of birth control.

Prerequisite: Population Sciences 203c,d. and a year of calculus, or consent of Instructors.

Population Sciences 190c,d. Ecology and the Spatial Distribution of Population (Sociology 190)

Lectures. *Two one and one-half hour sessions each week.* Dr. KEYFITZ.

Credit 5 units.

The environment and its population carrying capacity as a function of technology; agriculture and transport as determinants of population distribution and urbanization; ecological dominance and succession in human and sub-human communities; poles of development; territoriality and population growth; the dynamics of migration.

Population Sciences 192a,b. Problems of Population (Sociology 192).

Lectures. *Two one and one-half-hour sessions each week, first and second periods.* Dr. KEYFITZ and Dr. PULLUM.

Credit 5 units.

History of population theories and doctrines; growth of world population from 1600 to 2000; social determinants of fertility, mortality, and migration; effects of stationarity; past and prospective population policies and their effects.

Population Sciences 200a,b. Determinants, Consequences, and Control of Population Growth

Lectures and seminars. *Two one-hour sessions each week, plus one*

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two-hour seminar/laboratory session every week, first and second periods.
Dr. PLANK, Dr. VAILLANT and Dr. McINTOSH.

Credit 5 units.

The determinants of population growth are births, deaths, and migrations. The bio-social forces regulating each of these are examined, and the consequences of continued rapid population increase and alternative projections are considered. The physiology of reproduction is reviewed and methods and programs for its control are evaluated. The ethical and policy issues of births and population growth are also discussed. Concepts are illustrated by historical and current references. A term paper is required.

Population Sciences 201a,b. Determinants, Consequences, and Control of Population Growth

Lectures. *Two one-hour sessions each week, first and second periods.* Dr. PLANK, Dr. VAILLANT and Dr. McINTOSH.

Credit 2.5 units.

This course consists of the lecture series for course 200a,b. It is intended only for those students who are not concentrating in the Department of Population Sciences and who are unable to fit the full course (200a,b) into their schedules.

Population Sciences 202c,d. Departmental Seminar

Seminars. *One two-hour session each week, third and fourth periods.* Staff of the Department.

Credit 2 units.

This course is oriented toward the research interests of those concentrating in the department. Each student selects a topic for special study on which he presents a critical survey of the relevant literature and later the design of a project which would provide new information. During the initial sessions, and on occasion thereafter, staff members and guests report on their own investigations.

Population Sciences 203c,d. Demographic Methods

Lectures. *Two two-hour sessions each week, third and fourth periods.*

Laboratory. *Two hours each week, third and fourth periods.*

Credit 5 units.

Ways of measuring mortality, fertility, and migration, projecting future populations, and adjusting and correcting data are presented. In addition, the course is concerned with the design and analysis of fertility and migration surveys, methods for evaluating family planning and other population programs, and ways of organizing data for computer-aided analysis.

Prerequisite: Biostatistics 101a,b or consent of Instructor.

Population Sciences 204c,d. Biological Basis for Fertility Control

Lectures. *Two one-hour sessions each week with a third hour at the discretion of the Instructor, third and fourth periods.* Dr. SALHANICK and Staff of the Department.

Laboratory. *Six two-hour sessions to be arranged.*

Credit 5 units.

This course presents the fundamental physiology and biochemistry related to known and potential methods of family planning. Topics covered are: the biosynthesis, secretion, effects and modes of action of the gonadal and gonadotropic hormones; relationship of the natural steroid hormones to synthetic analogues. Laboratory sessions include demonstrations of a family planning clinic, an infertility unit and, procedures for sterilization and pregnancy termination.

Prerequisite: Population Sciences 200a,b and appropriate science background.

Population Sciences 205c,d. Readings in Population Studies

Seminars. *One two-hour session each week, third and fourth periods.* Staff of the Department.

Credit 2 units.

This course is an introduction to the literature pertaining to population theory, research, and fertility control programs. It is offered for students concentrating in the Department. Seminar discussions are directed toward the analysis and evaluation of the assigned selections.

Population Sciences 206c,d. Current Research on Population Problems

Seminars. *One two-hour session each week, third and fourth periods, and four hours each week supervised study.* Dr. SNYDER.

Credit 2.5 units.

This course is designed for physicians and other students with a biological background who are interested in field work on population problems. Important papers from current periodicals on topics of general interest are selected for study and evaluation, in order to develop an ability to read the literature analytically.

Prerequisite: Population Sciences 200a,b or equivalent.

Enrollment restricted to 4 to 12 participants, subject to approval of the Instructor.

Population Sciences 207c,d. Population Control Programs: Design, Management and Evaluation

Lectures and Seminars. *A one-hour lecture and a one-to-two-hour seminar each week, third and fourth periods.* Dr. WYON and Staff of the Department.

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Credit 2.5 units.

Many countries and funding agencies support programs intended to decelerate population growth, but their effectiveness is controversial. This course reviews examples of existing programs and related research, investigates their conceptual basis, examines evidence for broader considerations, and attempts a synthesis along the lines suggested by the evidence. Accounts of field studies in the United States and in developing countries illustrate these principles.

Prerequisite: Population Sciences 200a,b, Biostatistics 101a,b, and Epidemiology 201a or equivalent background.

Population Sciences 208c,d. Population and Disequilibrium in Developing Countries

Seminars. *One two-hour session each week, third and fourth periods.* Dr. KEYFITZ, Dr. PULLUM, Dr. THOMAS and Staffs of the Center for Population Studies and the Department of Population Sciences.

Credit 5 units.

Seminars deal with the interactions of population change, rural development and urbanization in developing countries. Faculty and students compare approaches as applied to models of population equilibrium at the levels of the family, village and larger regions, and study the process of disequilibrium caused by migration, mortality, technology, and human aspirations. Students present team term papers and at least one seminar.

Enrollment is subject to approval of the Instructor.

Population Sciences 210e. Evaluation and Management of the Infertile Couple

Lectures and Field Visits. *Daily lectures during the one-week reading period between the Fall and Spring terms.* Dr. McINTOSH and Staff.

Credit 1 unit.

Primarily intended for students who will be working in family planning programs, this course deals with the evaluation and management of the infertile couple and the desirability of providing infertility services in family planning programs. The organization and operation of an infertility unit and methods for describing the population evaluated are discussed. Films of specific diagnostic procedures and a visit to the Fertility and Endocrine Unit at the Boston Hospital for Women are included.

Enrollment is limited and subject to the approval of the Instructor.

Prerequisite: Population Sciences 200a,b and medical science background.

Population Sciences 285c,d. Applied Mathematical Demography Seminar (Sociology 285)

Seminar. *One two-hour session each week, third and fourth periods.* Dr. KEYFITZ and Dr. PULLUM.

Credit 5 units.

Research on topics of Population Sciences 185a,b.

Enrollment is subject to approval of the Instructors.

Population Sciences 300. Tutorial Programs

Time and credit to be arranged.

Students at the master's level may make arrangements for tutorial work and special reading on topics related to population problems. There may be an opportunity to consider the design of studies, programs or analysis of data.

Population Sciences 330e. Field Visits

One-week period between Fall and Spring terms or one-week period between Third and Fourth quarters.

Credit 1 unit.

Students concentrating in the Department of Population Sciences may participate in visits to organizations currently active in demographic studies, community education, and research and service in fertility control.

Additional Field Study

At the end of the academic year, a field visit may be arranged for students majoring in the Department of Population Sciences.

Limited to ten students.

Population Sciences 350–356. Research

Candidates for doctoral degrees may undertake research in the Department or may integrate research in population sciences with a doctoral program in another department or at the Center for Population Studies.

Members of the Department and of the Center for Population Studies are currently engaged in research in the following areas:

350 *Topics in Field Studies and Programs*, Dr. SNYDER, Dr. WYON, Dr. PLANK, Dr. GUERRERO, and Dr. BERGGREN.

351 *Topics in Biomedicine and Reproductive Physiology*, Dr. SALHANICK and Dr. McINTOSH.

352 *Topics in Demography*, Dr. KEYFITZ and Dr. PULLUM.

353 *Topics in Population Ethics*, Dr. DYCK and Dr. POTTER.

354 *Topics in Population Policy*, Dr. REVELLE and Dr. SNYDER.

355 *Topics in Population Economics*, Staff of the Department.

356 *Topics in Population and Resource Interaction*, Dr. REVELLE, Dr. THOMAS and Dr. ROGERS. (Center for Population Studies)

Department of Sanitary Engineering

HAROLD A. THOMAS, JR., S.B., S.M., S.D., Gordon McKay Professor of Civil and Sanitary Engineering

J. CARRELL MORRIS, S.B., A.M., PH.D., A.M. (hon.), Gordon McKay Professor of Sanitary Chemistry

JOSEPH J. HARRINGTON, B.C.E., A.M., PH.D., Associate Professor of Environmental Health Engineering

The Courses in which members of this Department participate in the School of Public Health are listed under the Environmental Health courses on pages 88 and 90 (Environmental Health Interdepartmental 201a,b and 208a,b).

The following courses of instruction offered in the Division of Engineering and Applied Physics of the Graduate School of Arts and Sciences are open to properly qualified students:

Engineering Sciences 171 (formerly Engineering 271a). Chemistry of the Aqueous Environment

Half course (*fall term*). M., W., F., at 11, and laboratory hours to be arranged. Professor BUTLER.

Chemical principles applicable to environmental science and engineering. Physical chemistry of aqueous media with emphasis on solution and heterogeneous equilibria. Principles of analytical chemistry and their application to analysis of water. Sources, occurrence, and chemical reactions of important constituents in natural waters.

Prerequisite: Chemistry 6 or equivalent.

Engineering Sciences 173 (formerly Engineering 273a). Introduction to Environmental Microbiology

Half course (*spring term*). M., W., F., at 11, and laboratory hours to be arranged. Professor MITCHELL.

To be given in 1974-75.

Introduction to Microbiology. Emphasis on microbial ecology. Application to problems in water pollution.

Note: This course cannot be taken for credit in addition to the former Engineering 273a.

Prerequisite: Biology 19 or equivalent.

Engineering 250a. Design of Water Resource Systems

Half course (*fall term*). M., W., F., at 8. Professor THOMAS.

Principles of engineering and economic analysis applied to water resource systems. Functional design of comprehensive management systems for collection, storage, conveyance, treatment and distribution of water uses. Techniques of operations research and econometrics to develop methods for planning integrated systems of dams, reservoirs, canals, pipelines and networks, pumps, and treatment plants.

Prerequisites: Applied Mathematics 105a; Engineering Sciences 121, 123 or equivalents.

Engineering 250b. Design of Water Resource Systems

Half course (*spring term*). M., W., F., at 8. Professor THOMAS.

Continuation of Engineering 250a, with emphasis on non-linear systems and systems with stochastic components. Application to multiunit systems for industrial, municipal, and agricultural water supply, navigation, hydropower conservation of wildlife, and the preservation and enhancement of the environment.

Prerequisite: Engineering 250a. Statistics 190 or equivalent desirable.

Engineering 253. Stochastic Processes

Half course (*fall term*). M., W., F., at 9. Professor FIERING.

To be given in 1974-75.

Theory and applications of stochastic processes and time series for environmental and social problems, including hydrology, delivery of medical care, statistical evaluation techniques, birth-death processes, hazard perception, insurance, and queues.

Prerequisites: Engineering 250a or Engineering Sciences 119; Statistics 190.

Engineering 254. Mathematical Programming for Large Systems

Half course (*spring term*). Hours to be arranged. Associate Professor ROGERS.

Application of optimizing theory to large environmental control systems. Practical problems involved in formulation and computation of mathematical programming models for these systems. Decomposition, multi-level and multi-objective planning, stochastic and mixed integer programming.

Prerequisite: Economics 2140b or 2140c.

Engineering 268. Transport Phenomena in Aquatic Systems

Half course (*spring term*). M., W., F., at 9. Associate Professor SPIELMAN.

Principles of convective and molecular transport of mass, momentum and

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energy in laminar and turbulent flows; emphasizes nonequilibrium systems with strong coupling between physicochemical rate processes and hydrodynamics; forced and free convection; estimation of molecular transport coefficients; theory of the residence time distribution and its application to rate processes in natural flows and process technology.

Engineering 270. Engineering Systems for Environmental Control

Half course (*spring term*). M., W., F., at 10. Associate Professor HARRINGTON.

Provision of urban water; engineering aspects of the collection and disposal of spent water and solid wastes; significant interchanges between the gaseous, liquid and solid phases of the environment; geographic interchanges; time-dependent developments. Data collection and processing for monitoring and control; maintenance and operation of pollution control systems.

Prerequisite: Engineering Sciences 123.

Engineering 272. Water Quality and Its Management

Half course (*spring term*). Tu., Th. 11-12:30. Professor MORRIS.

Nature, sources and effects of inorganic and organic impurities in natural waters. Water quality standards. Effects of water use on quality. Natural purification of surface waters. Chemistry of water and waste-water treatment. Water renovation and reuse.

Note: This course cannot be taken for credit in addition to the former Engineering 271b.

Prerequisites: Engineering Sciences 173 and the former, Engineering 271a now Engineering Sciences 171. Engineering 268 should be taken concurrently.

Engineering 273. Water Pollution Microbiology

Half course (*fall term*). Hours to be arranged. Professor MITCHELL.

To be given in 1974-75.

Advanced discussion of the role of microorganisms as both pollutants and purifying agents. Particular attention to ecological approaches to pollution control. Eutrophication, microbial imbalances, pesticides, stream purification, and a critical discussion of current waste treatment methods.

Prerequisite: Engineering Sciences 173 or equivalent.

Engineering 274. Chemical Models of Natural and Polluted Waters

Half course (*spring term*). Hours to be arranged. Professor BUTLER.

Chemical aspects of aqueous environmental systems within the framework of mathematical modeling. Models are based primarily on thermodynamic equilibrium, but can include kinetic processes and hydrodynamic processes as well. Emphasis on developing realistic predictive models for actual cases en-

countered in water quality management, pollution control, limnology, oceanography, and geology.

Prerequisites: Physical chemistry (e.g. Engineering Sciences 171), and some experience in computer programming.

Engineering 275. Water and Air-Borne Particulates

Half course (*fall term*). M., W., F., at 11. Associate Professor SPIELMAN.

To be given in 1974-75.

A generalized approach to particles suspended in water and air: hydrocolloids, microorganisms, oil-in-water dispersions, dust, smokes, and smog. Particle size distributions and their measurement (with demonstrations); formation by precipitation and by breakups; light scattering; captive and interactions with surfaces; behavior in assemblages; kinetics of aggregations; rate and fate of particulates in natural water and in urban atmospheres.

Prerequisite: Engineering Sciences 123, or equivalent.

Engineering 277. Surface Chemistry

Half course (*fall term*). M., W., F., at 10. Professor MORRIS.

To be given in 1974-75.

Liquid surfaces and surface-active materials. The Gibbs equation. Two-dimensional equations of state. Adsorption at solid surfaces. The colloidal state. Electrokinetic phenomena. Structure, surface properties, and colloidal behavior of hydrous oxides and silicate minerals.

Prerequisite: the former Engineering 271a, now Engineering Sciences 171.

Engineering 278. Rate Processes

Half course (*fall term*). M., W., F., at 10. Professor MORRIS.

Chemical kinetics, with emphasis on reactions in aqueous systems, diffusion and enzyme-mediated processes. Interpretation of kinetic data. Inorganic reaction mechanisms. Fast reactions. Reactions dynamics in water and waste treatment.

Prerequisite: The former Engineering 271a, now Engineering Sciences 171, or equivalent.

Engineering 279. Applied Electrochemistry

Half course (*spring term*). Hours to be arranged. Professor BUTLER.

To be given in 1974-75.

Dynamic interpretation of electrochemical processes. Electrode kinetics, the electric double layer, and electrokinetic phenomena. Applications to chemical processes, metallic corrosion, passivity, cathodic protection, batteries, fuel cells, and environmental science.

Prerequisite: Chemistry 60 or similar background.

Department of Tropical Public Health

THOMAS H. WELLER, A.B., S.M., M.D., LL.D., Richard Pearson Strong Professor of Tropical Public Health, Director of the Center for the Prevention of Infectious Diseases, *and* Head of the Department

Faculty: Professor Chernin; Associate Professors Berggren, Michelson, Morrow, Pan and Spielman; Assistant Professors Boyer, Coolidge, Lehman and Mott; Lecturer Daggy

The health problems of the tropical regions, as in poorly sanitized areas of the world elsewhere, are predominantly of an infectious and nutritional nature. The infectious diseases are the primary concern of the Department of Tropical Public Health, with particular emphasis given to protozoal, helminthic, and viral entities and to relevant arthropod and molluscan intermediate hosts. Within the framework of the Center for Prevention of Infectious Diseases, the Department of Tropical Public Health shares with the Department of Microbiology the responsibility for an integrated presentation of information on important infectious agents that produce disease in man. Emphasis is given to the ecology and epidemiology of the major infectious diseases and to their prevention and control.

The resolution of the health problems of tropical areas, as elsewhere, requires not only a specific knowledge of diseases but a multidisciplinary approach involving a considered appraisal of human resources as well as of relevant social, economic, and political factors. This elemental concept underlies the teaching program of the Department of Tropical Public Health, and is exemplified in the course, Tropical Public Health 203d, Perspectives in Tropical Health, open to all students. However, the student concentrating in the Department in preparation for a career in the field of international health should, in addition to Departmental courses, acquire a broadened experience by elective work in other areas under the aegis of the Division of International Health.

The basic course, Tropical Public Health and Microbiology 201a,b, is designed to provide students in the Master of Public Health program with newly-elaborated knowledge regarding major infectious diseases, and with the factual information concerning the epidemiology and control of selected entities of public health importance. Students concentrating in the Department will normally be expected to elect Microbiology and Tropical Public Health 202b, Tropical Public Health 203d, and Tropical Public Health 204c. Other advanced courses in Tropical Public Health are considered electives, to be selected on the basis of individual student interest and need.

The investigative program in the Department is broad and currently deals

with pathogens ranging from viruses to helminths. Thus, studies on the *in vitro* cultivation and the physiology and immunology of a wide variety of agents are in progress. Biological investigations on the molluscan vectors of the schistosomes comprise another area of major interest. Facilities are available for the training of a limited number of students at the Doctor of Public Health or Doctor of Science level, who may wish to spend a minimum of two years with emphasis on a program of original research. Due to time limitations, the Doctor of Science applicant should, in so far as possible, obtain the necessary medical science background prior to enrollment. Collaborative arrangements established with institutions in the tropics provide diversified opportunities for study and research overseas.

Tropical Public Health and Microbiology 201a,b. Ecology and Epidemiology of Infectious Diseases

Lectures, seminars, and laboratory exercises. *Three one-hour sessions and one three-hour session each week, first period; one one-hour session and two two-hour sessions each week, second period.* Dr. WELLER, Dr. NICHOLS and Staffs of the two Departments.

Credit 4 units.

This course provides an integrated presentation of information on communicable diseases of major public health importance. Exercises include discussions of the present status of infectious diseases in the developed and the developing areas of the world, and of procedures for their control from community to international levels. The course assumes a medical school background and an understanding of the pathogenesis of disease produced by bacteria, fungi, helminths, protozoa, rickettsiae, spirochetes and viruses.

Microbiology and Tropical Public Health 202b. Current Research in Infectious Diseases

Seminars. *One two-hour session each week, second period.* Dr. CHERNIN, Dr. VINSON and Staffs of the Departments of Microbiology and Tropical Public Health.

Credit 1 unit.

(Course is described under Department of Microbiology.)

Tropical Public Health 203d. Perspectives in Tropical Health

Lectures and conferences. *One two-hour session each week, fourth period.* Dr. WELLER and Guest Lecturers.

Credit 1 unit.

This course provides background information on environmental, social, economic, and political factors that influence health programs in the tropics. At each session a distinguished guest lecturer covers an assigned topic in-

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cluding such subjects as the development of professional education, problems of agriculture, nutrition, and water supply, and the political background of international cooperation. Each presentation is followed by informal student discussion. Enrollment is open to all students.

Tropical Public Health 204c. Public Health Aspects of Parasitic Diseases

Lectures, seminars, and laboratory exercises. *Two three-hour sessions each week, third period.* Dr. PAN, Dr. COOLIDGE and Staff of the Department.

Credit 2.5 units.

This course amplifies material presented in the basic course, and additionally provides coverage of significant parasitic entities not dealt with in Tropical Public Health-Microbiology 201a,b. Concepts relevant to the investigation and control of parasitic diseases, such as quantitation of infection, are stressed. Selected examples of control programs are examined. In the laboratory, the student becomes familiar with techniques essential for the epidemiologic investigation of the important parasitic diseases of man.

Enrollment is limited and is subject to the approval of the Instructor.

Tropical Public Health 205c. Clinical and Pathologic Features of Tropical Diseases

Case presentations, clinico-pathologic conferences, and demonstrations. *One two-hour session each week, third period.* Dr. WELLER, Dr. MORROW, Dr. COOLIDGE, Dr. VON LICHTENBERG and Staff of the Department.

Credit 1 unit.

This course, designed for students particularly interested in tropical medicine, supplements material presented in Tropical Public Health-Microbiology 201a,b. The emphasis is on the clinico-pathologic aspects of tropical diseases. At each session disease entities are introduced by presenting a clinical case; and pertinent clinical and pathologic features of the disease are then reviewed.

Enrollment is subject to the approval of the Instructor.

Tropical Public Health, Microbiology and Epidemiology 206d. Tuberculosis

Seminars. *One two-hour session each week, fourth period.* Dr. MORROW, Dr. MACK, Dr. BERGGREN, and Dr. MULL.

Credit 1 unit.

The purpose of this course is to provide an understanding of the ecology and the public health significance of tuberculosis. Emphasis is on tuberculosis control in the less-developed countries. Seminars focus on the microbiological, epidemiological, cultural, and economic factors which influence the form and effectiveness of tuberculosis control. Consideration is given to methods of analyzing the costs and benefits of national tuberculosis control programs.

Tropical Public Health 207d. Introduction to Molluscs of Public Health Importance

Conferences, laboratory and field exercises. *One three-hour session each week, fourth period.* Dr. MICHELSON.

Credit 2 units.

To be given in 1974-75; alternates yearly with Tropical Public Health 208d.

This is an introductory course designed to acquaint the student with the molluscs which may act either as active or passive agents for the dispersal of pathogens, toxins, or parasites which cause disease in man. Special emphasis is given to snails which serve as intermediate hosts of mammalian schistosomes. Students are offered the opportunity to study field and laboratory techniques necessary for an understanding of the taxonomy, morphology, cultivation, ecology and control of these medically important molluscs.

Enrollment is subject to the approval of the Instructor.

Tropical Public Health 208d. Epidemiology and Control of Schistosomiasis

Seminars and laboratory exercises. *One three-hour session each week, fourth period.* Dr. MICHELSON, Dr. CHERNIN, Dr. PAN and Dr. WELLER.

Credit 2 units.

To be given in 1973-74; alternates yearly with Tropical Public Health 207d.

The problems posed by schistosomiasis as an expanding health hazard are presented in a series of seminars and laboratory exercises. Emphasis is given to the biology of snail vectors, to problems of assessment of significance of the disease, and to the potentials of various approaches to control. Opportunity to become familiar with appropriate techniques is afforded in the laboratory.

Enrollment is subject to the approval of the Instructor.

Tropical Public Health 209d. Introduction to Medical Entomology

Conferences, laboratory, and field exercises. *One three-hour session each week, fourth period.* Dr. SPIELMAN.

Credit 2 units.

To be given in 1973-74; alternates yearly with Tropical Public Health 210d.

This course deals with the insects, ticks, and mites of public health importance. The manner in which arthropods transmit disease and the principles of vector control are discussed from ecological, physiological and genetic points of view. Colonies of various vector species are maintained by the students to provide the basic material for study of life cycles and for arthropod identification. Laboratory and field exercises demonstrate entomological techniques currently employed by epidemiologists.

Enrollment is subject to the approval of the Instructor.

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Tropical Public Health 210d. Current Problems in Malariology

Seminars and laboratory exercises. *One three-hour session each week, fourth period.* Dr. CHERNIN, Dr. SPIELMAN, Dr. WELLER and Staff of the Department.

Credit 2 units.

To be given in 1974-75; alternates yearly with Tropical Public Health 209d.

This course supplements the subject material on malaria offered in Tropical Public Health-Microbiology 201a,b and Tropical Public Health 204c. Particular attention is given to problems now encountered in eradication and control programs. In the laboratory, experience is provided with procedures essential to the epidemiologic investigation of malaria.

Enrollment is subject to the approval of the Instructor.

Epidemiology, Microbiology and Tropical Public Health 214c,d. Case Studies in Epidemiology of Infectious Disease

Seminars and laboratory exercises. *One two-hour session each week, third and fourth periods.* Dr. MACK, Dr. MORROW, Dr. LANGMUIR and Dr. NICHOLS.

Credit 2.5 units.

(Course is described under Department of Epidemiology)

Tropical Public Health 300a,b,c,d,e. Tutorial Programs

Laboratory exercises. *Time and credit to be arranged.*

Individual work for candidates at the Master's degree level may be carried out under supervision of a member of the Department. Various parasites of medical importance are maintained and are available for studies on metabolism, host-parasite relationships, and chemotherapy. Arrangements are subject to the approval of the Instructor.

Tropical Public Health 350. Research

Doctoral candidates or qualified full-time special students may undertake original investigations in the laboratory or in the field by arrangement with the Head of the Department.

Members of the Department are currently engaged in the following areas of research:

351 Tissue culture, organ culture, and immunological techniques as applied to problems in medical virology (Dr. WELLER).

352 Cultivation *in vitro* of parasitic helminths, protozoa, and other invertebrates of medical importance (Dr. WELLER, Dr. CHERNIN and Dr. PAN).

353 Biology, host-parasite relationships, and control of molluscan vectors of schistosomiasis and of other parasitic infections (Dr. CHERNIN, Dr. MICHELSON and Dr. PAN).

354 Population genetics, nutrition, and reproduction of medically important arthropods (Dr. SPIELMAN).

355 Arthropod transmission of viral, protozoan, and helminthic agents (Dr. SPIELMAN).

356 Etiology and epidemiology of mycobacterial diseases (Dr. MORROW).

FIVE

SPECIAL PROGRAMS

Programs in International Health

The School of Public Health affords opportunities for a comprehensive program of teaching, research, and service in international health. Various programs available within the School, together with related course offerings in other divisions of Harvard University and the Massachusetts Institute of Technology, offer the student a broad background in preparation for future careers in the World Health Organization, the Agency for International Development of the U.S. State Department, the Department of Health, Education, and Welfare, the Peace Corps, the Armed Forces, industrial organizations, mission groups, philanthropic foundations, or with other governments and agencies providing varied careers in international health and in planning health services for developing countries.

Other divisions of Harvard University—namely the Medical School, Faculty of Arts and Sciences, Graduate School of Government, Center for Middle Eastern Studies, East Asian Research Center, and Development Advisory Service of the Center for International Affairs provide additional opportunities for study in medicine, economics, public administration, anthropology, government, social relations, language, and related subjects for students with special interests in particular regions of the world. Cross-registration opportunities are also available for students interested in similar course offerings given by the Massachusetts Institute of Technology.

Courses may be selected leading to the Master of Public Health or Master of Science degree. Advanced students may be accepted as candidates for the Doctor of Public Health or Doctor of Science degree. A three-year residency program for physicians preparing for certification by the American Board of Preventive Medicine in the area of General Preventive Medicine (International Health) is also available to selected students. Areas in which supervised field work or research may be undertaken will vary, depending on current opportunities afforded, the availability of qualified supervision, and provisions for financing.

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International House, the School's residence for its graduate students and their families, provides an unusual opportunity for international contacts and extracurricular activities with professional health workers from a variety of countries. Throughout the year there are opportunities for informal interchanges of ideas among students and their families. In addition, there are frequent discussions on topics of international interest, including presentations by international students on the culture, geography, social structure, and health problems of their home countries.

Program in Occupational Medicine

The School offers to qualified applicants the two years of academic training requisite to certification in Occupational Medicine. Physicians may enroll in this program through any of the master's degree programs offered by the School. Physicians planning an academic or research career may be accepted for work toward a doctoral degree in occupational medicine or environmental health. Other students may elect a second year of formal courses and tutorial study in occupational medicine and public health. The usual course content of the first-year program is listed under the Master of Industrial Health degree. Additional courses and course content may be found under the departmental listings. In addition, as in other programs of the School, it is possible to cross-register with other Harvard faculties and with Massachusetts Institute of Technology to pursue special interests.

Clinical experience is offered in certain of the Harvard-affiliated hospitals where both occupational and non-occupational disease can be seen. Further experience is obtained through the University Health Services at Harvard (approved for third year, in-plant residency) and the Occupational Medical Services at Massachusetts Institute of Technology. Experience in an industrial medical department can be arranged during the summer months in selected local industries to supplement the academic training.

Financial support from the School is extremely limited. For more detailed information on various aspects of the Program address inquiries to Dr. James L. Whittenberger, Professor and Head, Department of Physiology, Harvard School of Public Health.

Program in Health Policy and Management

A new interdisciplinary, University-wide program was instituted in the fall of 1973 to prepare college graduates for careers as health planners, analysts, and managers. The program provides background in: 1) biology and medicine, to enable graduates to deal knowledgeably with physicians and other health professionals and with data collected by these people, and 2) quantitative approaches applicable to the health field, including the analytic sciences, economics, administration, and public policy.

The first year consists of graduate courses at the School of Public Health in human biology and medicine, quantitative analysis of health problems, environmental health evaluation and management, and perspectives on health care and introduction to welfare and health economics. These courses are described under Interdepartmental Courses.

During the second year, students have as options a program oriented to health management developed with the Harvard Business School, a program oriented toward health policy developed with the J. F. Kennedy School of Government, and a program in several health specialty areas offered by the School of Public Health. Upon successful completion of the program, a student will receive a Master of Science degree.

For those students who wish to continue on to a doctoral degree, a doctoral program is being developed. This would include an internship in a policy-making or operating health agency outside the School, where the student would have a research experience, which could be the subject of his (her) doctoral dissertation.

Further information may be obtained by writing to the program coordinator, Dr. Joseph J. Harrington, Associate Professor, Harvard School of Public Health, 665 Huntington Avenue, Boston, Massachusetts 02115.

Postdoctoral Fellowship Program in Dental Public Health and Ecology

The School of Dental Medicine, in cooperation with the School of Public Health and the Massachusetts Department of Public Health, offers a program covering three academic years of postdoctoral study, intended to prepare a limited number of individuals for creative full-time teaching, research or administrative careers in dental public health and dental ecology. Each person accepted into the program will be appointed as a Clinical or Research Fellow in Dental Ecology at the School of Dental Medicine. The program is open to dentists, dental hygienists, and other qualified health professionals.

The program is in three parts of approximately one year each, which need not be completed in succession. One part of the program involves a formal course leading to a degree of Master of Public Health. Candidates with an M.P.H. or equivalent from another school, however, may be accepted into the program with one year advanced standing. The second portion involves a one-year supervised residency at the state or community level, in cooperation with the Massachusetts Department of Public Health. This residency meets the requirements of the American Board of Dental Public Health. The third portion affords opportunity for advanced didactic work and research at the School of Dental Medicine, the School of Public Health, other departments of the University and/or other institutions. Epidemiological or other research work can be carried on over the entire three-year period in a variety of situations involving either new or continued studies. A research thesis is prepared for presentation at the end of the third year.

Fellows in Dental Ecology who wish to become candidates for a degree in public health must meet the admission requirements of the respective programs in the School of Public Health.

Upon successful completion of this program, the candidate may receive the M.P.H. degree from the School of Public Health, and a

SPECIAL PROGRAMS

Certificate of Postdoctoral Study in Dental Ecology, and Certificate of completion of residency requirements from the Harvard School of Dental Medicine.

Academic study beyond the master's level may be arranged with the School of Public Health and other departments of the University.

For further information and application forms, write to Donald B. Giddon D.M.D., Ph.D., Professor and Head of Dental Ecology, Harvard School of Dental Medicine, 188 Longwood Avenue, Boston, Massachusetts, 02115.

Special Courses in Preparation for Careers in Teaching

The role of community-oriented instruction in medical education has, in recent years, been receiving increasing recognition. Major changes are taking place in the teaching of public health and preventive medicine, both in the United States and abroad. The challenge of expanding teaching responsibilities has led to a growing need for qualified teachers of public health, preventive medicine, and preventive dentistry in schools of public health, medicine and dentistry as well as in community-based health programs.

The interest of the Harvard School of Public Health in preparing students for teaching posts both within the United States and abroad is underscored by the fact that approximately 60% of the students plan to teach on a full-time basis following graduation from the School. The School has responded to their needs by developing a number of special courses in teaching methods to supplement the various programs of the twelve departments of the School. The major goals of these courses are:

1. To develop competence in the formulation of education policy in the field of community medicine and public health.
2. To introduce students to modern educational methods and media and enable them to utilize specific methods to implement their own instructional objectives.
3. To help students to develop patterns of self-education through which they may continue to increase their competence in teaching after completion of the program.

These courses may be taken as part of a program leading to either a Master of Public Health or Master of Science degree.

The objectives of the special courses are carried by means of special seminars, workshops, and tutorial instruction. Participants include faculty from other Harvard Schools as well as specialists in medical

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education from departments of community medical education from this country and abroad. The basic course provides an overview of principles of curriculum design, formulation of educational objectives, selection of teaching methods, and evaluation.

In addition, seminars are offered on special problems and issues associated with teaching community medicine and public health. The various approaches to teaching are considered in historical and geographical perspective and in relation to the changing goals of education in the health sciences.

Further information on the special courses may be obtained by addressing inquiries to Dr. Ascher J. Segall, Associate Professor of Epidemiology.

Residency Programs

The School offers approved residency training leading to certification by the American Board of Preventive Medicine in the following areas:

General Preventive Medicine, in the specialty areas of

Epidemiology

International Health

Health Services Administration

Occupational Medicine

Aerospace Medicine

Residency programs are three years in length and consist of one or two years of study leading to the Master of Public Health or Master of Science degree, and one or two years of more advanced work including supervised experience which may or may not be part of a doctoral program. The third year may be devoted to training in an approved industry, organization, or institution consistent with the specialty area.

Further details on the residency programs, including availability of financial support, can be obtained through the Director of Admissions.

Combined Degree Programs with Harvard Medical and Dental Schools

In response to trends in medical school curricula and increasing interest of medical students in community medicine and public health, the School offers admission to the Master of Public Health or Master of Sciences programs as part of a combined degree program. The medical or dental student admitted to this program can satisfy requirements for a public health degree within the four years usually required for the Doctor of Medicine or Doctor of Dental Medicine degree. Students from medical schools other than Harvard normally enroll full time for an academic year, after completion of at least two years of medical school. Harvard students are eligible for consideration after admission to the Medical School or the School of Dental Medicine. Such students usually enroll full time for the Fall Term of their third year and complete requirements for a public health degree either by enrolling full time in the Spring Term or by spreading their electives in public health over a longer period.

SIX

GENERAL INFORMATION

Fees and Expenses

The tuition fees for the academic year 1973-74 are listed below. These include the Health Service Fee for medical care and hospital insurance for all resident students. Each candidate for a degree must have a minimum of one year of residence at the School at full tuition.

1973-74

Full-time resident students	\$3,200
Half-time resident students	1,850

All students pay tuition at the above rates with the following exceptions:

Doctoral candidates or Special Students in the second or later years of a doctoral or special program:

Full-time resident students	1,850
Half-time resident students	1,000
Non-resident doctoral candidates, registered in absentia	200

Part-time Special Students, enrolled for less than half-time:

First credit unit of work	160
Each additional unit per term up to 10 units	75

Summer Session — Effective July 1, 1974

Students who register and receive credit for research or supervised study during 12-week summer period	\$475
Students registered for less than 12 weeks will pay at a proportionate rate.	

Payment of Fees

Bills for tuition and fees will be issued and payable as follows:

<i>Issued</i>	<i>Payable</i>	
At registration	Within 10 days	$\frac{1}{4}$ Tuition
Nov. 30	Dec. 15	{ $\frac{1}{4}$ Tuition Miscellaneous Charges
Jan. 30	Feb. 15	{ $\frac{1}{4}$ Tuition Miscellaneous Charges
April 30	May 15	{ $\frac{1}{4}$ Tuition Miscellaneous Charges
June 3*	June 10	{ Miscellaneous Charges
June 30	July 15	{ Miscellaneous Charges

Students who are candidates for degrees must have paid all dues to the University at least one day before the day upon which the degrees are to be voted. A student who leaves during the year is charged to the end of the tuition period in which he leaves, provided that he has given the Dean prior notice in writing of his withdrawal; otherwise he is charged to the end of the tuition period in which such notice is given.

A student who leaves the University for any reason whatever must pay all charges against him immediately upon receipt of a bill from the Comptroller's Office. Every student is held responsible for the payment of fees until he has notified the Dean of his intention to withdraw from the School.

All term bills are sent to the student at his local address unless the Comptroller's Office is requested in writing to send them elsewhere.

Any student whose indebtedness to the University remains unpaid on the date fixed for payment is deprived of the privileges of the University. Reinstatement is obtained only by consent of the Dean of the School in which the student is enrolled after payment of all

* Applies only to candidates for degrees.

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indebtedness and a reinstatement fee of \$10. In addition as a condition of reinstatement such student is required to file with the Comptroller a bond in the amount of \$1000 as security for the payment of future term bills.

Field Studies

Field opportunities, listed under each Department's course offerings and bearing the course number 330, often entail travel expenses that must be met by the student. Information about estimated expenses should be obtained from the appropriate Department.

Student Health Service

Under the University Health and Insurance Plan, students at the School of Public Health receive medical care and insurance toward hospital expenses. Medical care is provided through the facilities of the Medical Area Health Service, located in Vanderbilt Hall. The hospitalization insurance extends for a period of twelve months from September 1, and covers hospitalization in Boston and elsewhere. Research and Teaching Fellows who are in a training status are required to enroll in the Student Health Plan unless they can show that they have comparable coverage.

A prepaid program for the care of wives (including maternity benefits) and children of full-time students is available. As the plan provides extensive benefits for ambulatory and inpatient care, all who are eligible are strongly advised to enroll. Its coverage, like that of the Student Plan, extends for a period of twelve months from September 1, and provides full semi-private hospitalization benefits. Information about the plan for dependents is sent to students before registration or may be obtained from the Registrar.

Successful vaccination for smallpox within the previous three years is required of all students entering any of the schools of the University if the student comes directly from any area of the world where smallpox is currently endemic. A certification form for this purpose is sent to each student who is accepted for admission. The form is to be completed and returned *only* if the student comes directly from an endemic area.

Any illness necessitating absence from classes should be reported to the Medical Area Health Service Office by the student or an attending physician, and to the Registrar's Office at the School. A physician from the Medical Area Health Service, on call twenty-four hours a day, can be reached through the switchboard of Harvard University.

Housing

The Henry Lee Shattuck International House is an apartment residence operated on a nonprofit basis by the Harvard School of Public Health for its full-time students and their families from the United States and abroad. Located at 199, 203 and 207 Park Drive, within walking distance from the School, the House comprises sixty-one individual apartments, each with its own kitchenette and bath.

All apartments are rented furnished with basic items except for linens, blankets and kitchen utensils, and are leased for the ten-month period from September 1 through June 30. No unfurnished units are provided. Special arrangements can be made for summer rentals during July and August. Included in the monthly rent are hot water, heat, janitor service and all utilities except telephone. The necessary application forms and more detailed information may be obtained by writing to:

Mrs. Margaret D. Penrose
Director, Shattuck International House
Harvard School of Public Health
677 Huntington Avenue
Boston, Massachusetts 02115

Additional information on housing may be obtained, on personal application only, from the Harvard University Housing Office, 1737 Cambridge Street, Cambridge, Massachusetts 02138.

Loan Program

The Harvard School of Public Health is a participant in the Harvard University Federally Insured Student Loan Program. This program permits a student who either is a U.S. citizen or has immigrant

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status, to borrow up to \$2,500 a year providing he has less than \$10,000 in outstanding loans.

Detailed information about the loan program can be obtained by writing to the Director of Admissions, Harvard School of Public Health, 677 Huntington Avenue, Boston, Massachusetts 02115.

CREDITS FOR PHOTOGRAPHS

Rice C. Leach, page 2; Richard P. Lewis,
page 6; Harvard News Office, page 11.

